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## CUI BONO?

A GLANCE through the prospectus of the Electric Construction Corporation, Limited, would lead the casual observer to the conclusion that there is in store for the electrical industry no such calamitous catastrophe as the mammoth combination foreshadowed. Those who are not behind the scenes might also go so far as to say that since some combination, strong financially, is required to bring electric traction to a successful issue, if legitimate business is meant the parties to the Electric Construction Corporation are well suited to one another. Again, it is a recognised fact that in all industrial work the large manufacturers produce the manufactured article, regarded as mere labour and material, at a much cheaper rate than the small companies can possibly do, although the managerial expenses of the former are always higher. Still, another thing in favour of the scheme is that to an outsider there seems to be nothing about it in the way of a ring or corner; that there has been no attempt to effect a general combination of the electrical trades, and that, to all intents and purposes, it has all the appearance of an innocent amalgamation of two or three businesses. There are, however, other ways of looking at the construction of this Corporation.

A number of respectable men of commercial instincts have lent their names to a prospectus wherein we find statements which, to say the least of it, require some considerable curtailment. The Corporation, we read, "is established to supply the enormous demand for all kinds of electric machinery which has arisen in consequence of the remarkable development of electricity, both as an illuminating and a motive power, a demand which is daily increasing, and far exceeds the manufacturing power of existing works."

No doubt most existing works, and especially those forming part of this corporation, have all the elasticity requisite to supply the demand, excepting, perhaps, that of capital, and the prospectus would have been nearer the mark if it had read:—We have plenty of room at our works and offices, but we are not overpressed with money; the majority of us have never, or scarcely ever, paid dividends on our existing capital, but we hope to do so some day, provided our rivals close their shops meanwhile.

Among the assets which are to be purchased by the poor investor for the enormous sum of £397,300, of which £348,300 is to be in cash, are the patents of the Railway Electrical Contractors, Limited, and the patents of Julien of Brussels, and Sprague of New York. What do the Julien patents consist of? Does not the E.P.S. Company, in this very prospectus, claim a monopoly of the storage battery industry, and did it not sue (through its licensees) Julien in America? Where does the traction "system" of Julien come in? To the best of our knowledge, he has neither a motor nor gearing which he can call his own, nor an established reputation among us. Sprague's patents, again, have yet to prove their value, so far as England is concerned, and the large amount of successful work he has done in the United States is no criterion for our home wants. In fact, there is no demand at present for electric motors in the United Kingdom; but as soon as this arises there are already at least half a dozen good firms eager and willing to supply it with their own types and makes, which are probably as good as, and no doubt cheaper than, Sprague's.

Our own pioneers in electric traction have not been idle; they experimented and canvassed the country before Sprague dreamt of going in for motor work, and it was not want of skill or want of energy which kept the business back; it was only the absence of demand and the want of capital wherewith to demonstrate on a large scale the value of their respective systems. We are quite certain that the Electric Construction Corporation will not create any greater demand by attaching Sprague's name, or any other of foreign importation, to its prospectus; and if the necessary capital had been forthcoming, we had at any time the necessary engineering and technical skill at our own doors. We admit that tramway directors would not be justified in giving orders for electrical plant until a substantial saving is clearly demonstrated. That it *can* be demonstrated we know, but where is the company, corporation, or firm in this country who will go to a tramway company and declare itself ready to spend £10,000 on an experiment on condition that its success shall cause the company to completely equip its line. Our readers well know that no such combination exists, and we say, therefore, that a strong financial position is necessary for the corporation who would carry electric traction to a successful issue, as clearly and emphatically stating, however, that the proper way to commence business is not by purchasing, for a huge sum, patents of doubtful commercial value.

From this prospectus the public might almost conclude that Sprague and Julien were the *inventors* of the electric transmission of power, and that they possess a kind of monopoly, whereas the fact is that our own pioneers are merely waiting for Acts of Parliament, and money. Our tramway companies are not rolling in wealth, and if it is the object of the Electric Construction Corporation (and this they do not profess) to lend electric cars and the like to tramways, then they need not purchase the Julien patents which have no value in the avowed opinion of the Electrical Power Storage Company, nor the Sprague patents which refer more particularly to tramways with overhead conductors which will not be possible in our towns. Moreover, Sprague's motor and method of regulation have, we fear, long been anticipated, and it is questionable whether patents are worth paying much for, if there is any probability that they will, sooner or later, be contested.

Electric lighting, tramway traction, railway train lighting, mines, canals and general motive power, which form so prominent a part in this prospectus, are not monopolies for the Corporation, and many firms are quite as capable of doing all this as well, if not better than, those who have joined the Corporation. We know it as a fact that in every branch of electrical industry the power to supply at present in this country exceeds the demand; consequently we feel justified in drawing attention to the leading paragraph in this somewhat remarkable prospectus.

Another thing which we, with many others, fear, is that with their working capital the smaller manufacturers will be undersold. Of course, doing business at no profit, or at a loss, could not go on for ever; but with such an enormous sum to back up the Corporation it might last long enough to make the smaller fry agree that life was not worth living.

Finally, it would be an interesting study for a statistician to go into a calculation of the probabilities of ever getting the 10 per cent. promised on the £500,000, basing his estimates on the real value of the undertakings for which nearly four-fifths of this sum is to be paid. If time does not press too heavily on our hands we shall, perhaps, ourselves soon make the attempt.

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AS we anticipated, the dinner given on Friday evening last by the firm of Crompton & Co. proved a very enjoyable one. The viands and wines were excellent, the toast list was light, the speeches were short and the music was good, so that the evening passed away without that feeling of *ennui* which so often prevails at meetings of the kind. Mr. Crompton, who is always earnest in what he says, spoke very kindly of his past and present pupils and of the work they had accomplished, and it must have been encouraging to them to hear it publicly stated that the firm's present proud position in the electrical world was due in no small degree to the efforts of these same students. Mr. Crompton also spoke in the highest terms of the integrity and fearlessness of the English technical press, his graceful allusions to the usefulness of the electrical papers to such men as himself, being evidently the honest utterances of the true feelings which prompted him. Mr. Albright, too, was equally sincere in his brief speeches, and the impression must have made itself apparent to the assembled company, that real good feeling, of a nature which did one's heart good to see, existed between the firm, its pupils, customers and friends. Mr. Williams, who replied on behalf of the pupils, proved himself a born orator of a type now fast disappearing, and his sallies were worthy the creation of the author of Handy-Andy. Beneath an exterior which at first sight impresses the listener with some degree of awe, there is a depth of humour which is simply irresistible. Mr. Preece, too, was in unusually good fettle, and his Chaldæic researches on the origin of the Daniell cell were hugely enjoyed, but when by such logic as would have made the late John Stuart Mill turn green with envy he proved that Job was not only the inventor of the telephone, but a past pupil of Crompton & Co., hilarity reigned supreme. The Mayor of Chelmsford gave a very interesting little discourse on the proposed lighting of that town by the hosts of the evening, and Messrs. Kapp and Biggs made suitable replies to the toast of the "Press." Mr. T. H. Harrison and Mr. Basil Gee sang excellent songs, Mr. Gatehouse played the violin and Mr. Alfred Izard accompanied, and shortly before midnight the company separated and left the Café Royal, happier if not wiser men. We had almost forgotten that at one moment when the virtues of the electric light were being extolled and the enthusiasm of everybody had risen to that point where the "light of the future" throws every other illuminant into the shade, a sudden flicker, which might be almost termed a momentary extinction, brought the guests to their senses and their thoughts to the advisability of a hurried stampede, but in an instant everything was *Albright* again and nothing further interrupted the harmony of the evening. It was suggested that the suppliers of the electricity were trying to perform Mr. Mordey's celebrated sleight of hand feat of switching in machines in parallel, but we have not been able to verify this rumour.

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IF Philander Smiff had lived in our locality he would have modified his generic description of the London nightingale, by including not only his own specimen, but all and every of the cat tribe under the category of "beasts." Mr. Sibley's invention for abating the nuisance from the midnight concerts by electrically disposing of the performers, pre-supposes a guilelessness and a simplicity on their part that we have always found wanting in a well-regulated caterwauler. The inventor appears to imagine that given a backyard with a high fence, furnished with an array of sharp spikes on its summit, it will be necessary only to make a small hole at the bottom of the fence to persuade the animal that the nearest way to the next yard through the hole is preferable to climbing over the spikes. Now, a cat is a wayward beast, and in our experience we have observed repeatedly, when it wishes to transfer its body from one garden to another, instead of taking the shortest and most direct route, it will much rather run up the side of the house, enter at a window, presently make its exit from the highest chimney pot, and finally slide down the water pipe of the adjoining house. Presuming that the cat did creep through the hole, the apparatus provides for it receiving an electrical shock of sufficient power to silence its music for evermore. This result would be a most desirable one were it not that the animal, as a rule, has an owner, who, in whatever degree he may hate the tribe generally, would resent any injury to his own favourite. The invention, moreover, does not cover any means for the removal of the carcase, so until some improvement is devised, by which the cat when killed shall have its fur scattered around in a natural manner, as though it had been slain in mortal combat, we must rest contented with the older but most effective trap—a water butt, with tipping, self-righting, automatic-working lid. This is ever ready for action, and having done its duty once is instantly prepared to do it again, disposing of the dead body, and leaving not a mark behind to arouse the suspicions of any other wary feline.

THE United States cruiser *Chicago* is to be furnished with Lieut. Fiske's electrical apparatus for hoisting ammunition and projectiles from the magazine galleries to the fighting deck on board ship. The device has for its object the prevention of accident in the event of the operator being shot in action. In ships using steam ammunition hoists, it is necessary for the man at the steam brake to throw open and close the throttle in starting and stopping the hoist; should he be shot dead while a charge of powder or a heavy projectile was being lifted, there probably would not be any one ready at the very moment to step into his place and seize the throttle. The result would be that the tray would come in violent contact with the block overhead, the projectile would be thrown out, and, falling to the bottom of the ship, might under certain circumstances, explode in her vitals. To supply current to the electrical hoist, it is necessary for the operator to turn a small wheel during the whole time it is working; if the manipulator were to be shot or otherwise incapacitated, the tray would be brought to a standstill instantly, and the above possible disaster avoided. As at first constructed, it was found that after the movement of the wheel was stopped, the tray continued to ascend a short distance, then drop, again rise and fall, and finally stop. This oscillation was looked upon as being objectionable, and has now been eliminated, so that the tray stops at the same moment as the current is cut off.

THIS from the other side, as one of the conundrums of the day: What has become of the much talked of phonograph? While Colonel Gouraud still continues to warble its praises in Europe, and Mr. Edison sends messages to him to say that the commercial article is ready, the thirty or forty companies organised in America to look after phonograph interests are keeping exceedingly quiet.

THE repeated explosions in New York subways of accumulated gas are not only alarming to the public, but they have a tendency to corrupt their morals as well. We hear that it is becoming quite a common event now to bet on the next explosion, both as to the time of occurrence and the exact locality which will upheave. The investigations into the cause of these accidents do not furnish any clue as to how the gas became ignited. These explosions do not take place in other cities where subways are in use, nor did they in New York until comparatively recently. People are beginning to mutter, "surely an enemy hath done this."

THE Western Union Telegraph Company, having lost its case in the Supreme Court to restrain the local authorities from cutting down and removing their overhead lines has, it is rumoured, commenced another similar action in the Supreme Court, in which, though ostensibly the name of the Rapid Telegraph Company appears, the Western Union is the actual plaintiff.

WE believe that with the single exception of Barnet there is not another town in the United Kingdom lighted by incandescent lamps in series, and without the aid of transformers. It is somewhat odd that the Bernstein system has hitherto been regarded with indifference in this country, when the Heisler method of lighting in America, which is precisely similar in principle, should have met with an extended use.

IT is not unlikely that the Waltham Watch Company will in time manufacture none but non-magnetic watches, for which the demand is steadily increasing, and their reputation for producing good work at a fair price should ensure a ready sale for their wares. The Great Northern Railway Company has ordered twenty non-magnetic watches for use by the engineers and guards of the "Flying Scotchman."

CHICAGO, the city of underground wires, is to have its electric lighting plant considerably increased to meet the demands that come from every quarter.

FORTY-THREE electrical patents in one week, and 113 in three weeks, show the activity of the Americans in inventing new applications of electricity.

OUR English judges might with advantage follow the example of Judge Coxe, of New York, who, before giving his decision in the Storage Battery Suit, underwent a rigid course of electrical study.

ONE of the latest published reports in favour of overhead wires states that no underground system has ever worked satisfactorily for 90 consecutive days. This is certainly not correct, and the proposed extension of the system at Chicago by Prof. Barrett would seem to be a public refutation of the statement. A further remark, that the insurance companies in Boston have not lost one dollar on fires caused by electricity appears strange in face of the proposal by the Boston underwriters to raise the premiums on electrical risks.

## THE ELECTRICAL TREATMENT OF UTERINE TUMOURS.*

By JAMES H. AVELING, M.D., Consulting Physician to the Chelsea Hospital for Women.

ALL that my present experience will justify me in vouching for the efficacy of this method of treatment is that in some cases it will cause a fibroid tumour of the uterus to entirely disappear, that in others it will remove it partially, and that in most cases the symptoms which have caused the patient to seek assistance may be relieved or quite cured. In support of these statements I will briefly relate four cases which I have treated by electricity.

CASE I.—Miss L., aged 32, was first seen by me in 1882, when I found two small fibroids in the anterior wall of the uterus. She complained of pelvic pain extending down the legs, easily brought on and increased by exertion. Bromides and leeching relieved this and kept the growths in check. In 1884 I saw her again, and found a slight enlargement of the tumours, especially the one on the right. In 1887 this began to grow rapidly, and when measured on November 7th of that year its antero-posterior diameter was found to be three and four-tenths inches. Electrical treatment was begun on October 29th, 1887, abdominal positive, and intra-uterine negative electrodes being used, with a current of intensity varying from 60 to 150 milliampères for ten minutes about every four days, avoiding a few days before and after the catamenial periods. A higher intensity than 150 milliampères could never be borne, as the tumour was tender and the patient very sensitive. On January 14th, 1888, measurement showed that the fibroid had decreased in diameter from three and four-tenths inches to two and six-tenths inches, and the electrical treatment was continued until March 14th when, as it appeared the growth had ceased to diminish, galvano-puncture was employed with a current of 70 milliampères. The pelvic pain was much increased by this, and the patient complained of a "sore feeling" in the tumour. There was, however, no rise of temperature nor fever. The electrical treatment was suspended for five weeks. On April 13th measurement was again taken, and the tumour was found to be reduced from two and six-tenths to one and eight-tenths inches. On this day only a current of 60 milliampères could be borne. Gradually, however, the usual intensities were tolerated, and the treatment was continued until July 23rd, when measurement showed that only a slight reduction had taken place, it being one and six-tenths inch in diameter; and it is probable that nothing less than a repetition of the galvano-puncture will cause a further rapid diminution. Besides the diminution in the bulk of the growth other improvements accompanied the treatment. The periods, which had been irregular, with dark discharge and clots, became regular, of proper colour, and free from clots. The patient's face looks more healthy, and has lost the distressed appearance. She writes: "The waist is less by two inches, the body certainly smaller, and the pain decidedly less in intensity before, during, and after the periods." I am able for the first time to append a diagram showing the actual reductions in the diameter of the tumour observed at different dates as above mentioned.

CASE II.—Mrs. G., aged 38, has had no children. She was first seen by me in 1885, when she was suffering from excessive menorrhagia, and had a large fibroid reaching above the umbilicus. Treated by bromide and chloride of ammonium, ergot, rest, and hot-water syringing, the tumour diminished until it came to a level with the umbilicus, but beyond this I could not succeed in reducing it. January 9th, 1888, I began the electrical treatment with abdominal dispersing and intra-uterine electrodes, administering a negative electric current, varying from 80 to 160 milliampères. No galvano-puncture was used in this case. The treatment was continued during the inter-menstrual periods at intervals of four days, the number of electrisations being about six each month. At the end of February it was evident the tumour was diminishing, and thus encouraged, the treatment was continued with unabated success until July 19th, when the fibroid was found reduced to a remarkable extent. Her dress had been gradually taken in several inches, and the belt she was in the habit of wearing to support the tumour became useless and rode up to the waist. The uterus was causing some pressure in consequence of its being able to descend into the pelvis, and a support will probably soon be needed. The patient is delighted at having regained her figure, and, speaking of the enlargement, says she has now "quite to hunt for it." She is now practically rid of her incumbrance, although I hope to carry the treatment still further.

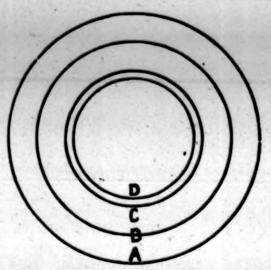

DIAGRAM I.—A, diameter of tumour November 7th, 1887, $3\frac{4}{10}$ inches. B, January 14th, 1888, $2\frac{6}{10}$ inches. C, May 13th, $1\frac{8}{10}$ inch. July 22nd, $1\frac{6}{10}$ inch.

CASE III.—Mrs. B., aged 30, has had no children; the periods irregular, occurring at intervals varying from five to nine weeks. She has pelvic pain, increased by standing. December 31st, 1887, I examined her under ether, and discovered a fibroid the size of a small egg bulging out from the left side of the cervix. January 1st, 1888, electrical treatment was begun with dispersing abdominal and intra-uterine electrodes; negative electricity of intensity varying from 75 to 175 milliampères was used for five minutes every two or three days. During this month it was administered 13 times. In February the treatment was continued in the same way, except upon the 6th, when galvano-puncture was employed through the roof of the vagina. After this the tumour, which had begun to diminish, continued to do so more rapidly. The ordinary electrical treatment was gone on with during March, and at the end of the month there was scarcely a trace of the fibroid discoverable. The pelvic pain had ceased, and the catamenial period had become regular. Electricity was discontinued, and when the patient was examined on May 8th the fibroid had utterly disappeared.

CASE IV.—Miss S., aged 41, catamenial period regular, but accompanied with membranes and clots. She has pelvic pain on the right side, and feels she cannot get about as comfortably as she did. I first saw her in December, 1887, when a fibroid was discovered in the posterior wall of the uterus the size of a closed fist, and it was causing inconvenience from its pressure in the pelvic cavity. In May, 1888, I saw the patient again, and found the tumour had increased rapidly in size, and could no longer be held in the pelvic cavity. Electrical treatment was commenced on June 7th. A negative current, of intensity varying from 85 to 125 milliampères was used and repeated seven times between that date and July 24th. On July 3rd the tumour was found to be unmistakably decreasing, and the patient had passed a period without membranes and clots. On July 10th the uterus had again descended into the pelvic cavity, and had diminished to the size it was when I first saw the case. The patient is still under treatment. She comes from the country by rail every time electricity is used, and returns the same day.

REMARKS.—It may be said I have been precipitate in publishing these cases; but although it is true we must wait years before we can pronounce cures permanently perfect, still in a few weeks we may be able to announce important results, such as the diminution of the tumour and the relief of serious symptoms. Of course we cannot but feel that the electrical method is still in its infancy, and that the results must improve with further experience. It would be absurd to imagine that all the possibilities of electricity were already known and exhausted. We must patiently work on until we have discovered to what extent it can be used in alleviating or removing the sufferings of humanity.

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* *British Medical Journal.*

It will be noticed that I have approached this method of treatment cautiously, and have used no high intensities, nor continued the current on any occasion more than 10 minutes. Nor have I used any greater strength of current than the patient could bear without an anæsthetic. I have used no special antiseptic precautions, but have observed most careful cleanliness, especially ordering vaginal syringing with hot water, and seeing that the intra-uterine and puncturing electrodes were perfectly innocuous. No serious symptoms have followed my use of electricity, nor has there been any rise of temperature or fever.* In two of the cases the tumours were rapidly increasing when treatment was commenced, and both began to decrease synchronously with the treatment. Some contend that these tumours become smaller by a natural atrophic process, and quite independently of electricity, but how do they account for tumours which have been rapidly growing, suddenly, upon the use of the battery, ceasing to increase and gradually diminishing in bulk? A repetition of these coincidences will perhaps in time open their eyes, and enable them to see the truth. One of these patients comes by rail from the country to have the electricity applied, returning the same day, and when at home going about as usual. This is an answer to those who say the progressive atrophy is due to rest. My cases also show that, although galvano-puncture is more rapid in its catalytic action, a great deal can be done without it. They also demonstrate that much good can be effected by currents of low intensity.

For electrical treatment I use Gaiffe's portable battery, from which I have always been able to obtain more power than I required. It has satisfied me in every respect save one. When driving about with it the fluid has escaped from the cells, and the woodwork has become so swollen that it has been difficult, and sometimes impossible, to screw the cells up to put the battery in action. I have overcome this difficulty, and the spilling of the fluid is completely obviated by fastening, with a ring, a piece of India-rubber sheeting with a hole punched in it, over the mouth of each cell. This little contrivance has saved me much time and vexation.

One last word about dispersing electrodes. I have tried many. What we require is a flat pad, with a smooth surface, capable of absorbing water and holding within it a sheet of metal capable of being accurately adapted to the varying forms of the abdominal surface. If one part of the plate be pressed nearer the epidermis than another, a larger amount of electricity will pass from the body at that point, and pain, with perhaps a deep sore, will result. The ordinary plate cannot be made to adapt itself to a nodular or irregular surface, for if you make it concave longitudinally you cannot do so laterally, nor can you make it assume a spherically concave form. To overcome this difficulty I first tried a flat spiral of copper wire, but this got out of shape and one coil of wire overrode another. I now use a metal plate cut into a spiral ribbon, which answers perfectly, adapting itself to any surface however uneven it may be. It is placed between amadou or washleather and spongio-piline. The dispersing electrode thus made should be soaked in hot water and applied to the abdomen before any other arrangements are made, so that the epidermis may become thoroughly saturated and consequently less resistant to the current. Care also must be taken that the metal plug connecting the rheophore with the plate does not touch the skin; and the patient should be taught to hold the electrode upon the abdomen with an even pressure. The best way of drying the electrode after use is to put it on the floor with its waterproof side down, then placing a folded towel over it to tread upon it.

Such is a brief sketch of the progress I have made with the electrical treatment of uterine tumours during the past year, and I think many will agree with me in concluding that the little experience we have already obtained widens our responsibility, and must make us pause in recommending and adopting the more dangerous methods of treatment before giving electricity a fair trial. Oöphorectomy and hysterectomy will, I fear, be necessary operations in some cases, but if the symptoms—pain, hæmorrhage, and bulk of tumour—which render the patient's life miserable or useless can, even in some cases, be safely removed by the battery, then I say with Dr. Keith it is nothing less than "criminal" to recommend these dangerous operations until the safer method has been skilfully tested and found to fail.

## THE APPLICATION OF ELECTRICITY TO MINING.

AN interesting paper on "Recent Development in the Application of Electricity to Mining" was read by Mr. F. G. Rowan, C.E., at the annual meeting of the Mining Institute of Scotland, held in the hall of the institute, Hamilton, on the 25th of last April. Some time ago Mr. Rowan read a paper on the same subject before this Institute, but in the present instance he confined his remarks principally to the employment of electricity for the transmission of power, especially as regards pumping, winding, and haulage. The first installations mentioned for pumping purposes are those at Trafalgar Collieries. The plant there consists of three sets. The first, of 1½ H.P., was put up in 1882; the second, using about 2½ H.P., was erected in 1886, and is working at about 800 yards from the surface; and the third, and largest set, was started in May, 1887. The electrically driven pump in the latter plant is of the double plunger type, fixed 2,200 yards from the generator, and 1,650 yards from the bottom of the shaft. It is driven by a leather link belt from the motor running at 650 revolutions per minute, and at this speed the pump can deliver 120 gallons per minute, with a 300 feet lift. The motor is of the Elwell-Parker 12-inch type, having an output of 13,000 watts, or rather over 17 horse-power. The dynamo, which is driven from an old marine engine, and stands above ground near the top of the shaft, is also of the same firm's make. It runs at 950 revolutions, the output being 17,000 watts. The cable employed is lead covered in the shaft, where it is enclosed in wooden boxes. In the roadways it is supported upon earthenware insulators, placed about 10 yards apart along the side of the road. The return cable is an old iron pit rope, 4 inches in circumference. According to figures furnished by the author, the cost per horse-power on water raised by this plant is ·02d., and the cost per thousand gallons of water raised is 1·80d.

Mr. Rowan next described the trial of the small electrical pumping plant in 1887 at Messrs. Locke and Co.'s colliery at Normanton. In this case it will be remembered that Messrs. Immisch supplied the dynamo and motor, and Messrs. Locke the pumps and piping. The result of this trial being so satisfactory, it was decided in February, 1888, to establish electrical machinery on a large scale. The installation was designed to raise 7,200 gallons per hour from a vertical depth of nearly 900 feet below the surface at one lift. The pumps are differential, and when doing full duty, work at 25 revolutions per minute. The dynamo and motor, which were constructed by the same electrical company, both run at 450 revolutions, the average current being 66 ampères. The engineer of the colliery states, as a result of 12 months' working, that the useful effect obtained is over 40 per cent. The engine is a compound semi-portable Robey, 30 H.P. nominal, indicating from 76 to 80 H.P., and working at 140 lbs. pressure. The total cost of the installation was £1,600.

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* Since writing this, I have been informed of considerable uterine disturbance and fever following my electrical treatment of a large uterine fibroid, but I am inclined to think the cause of it was the journey the patient took directly after the use of the battery.

Since the erection of this plant a small pumping installation of 20 H.P. has been put up in South Wales, but so far no details have been published. In Linlithgow, Scotland, there is at work an electrical installation for pumping water, and this possesses some interesting features. The motor and pump are situated at Kingscavil Quarry, near Linlithgow, where they raise water to a reservoir at a height of 135 feet, the water being forced through a distance of 600 yards of 2-inch pipes. The quantity of water raised is not stated, but the pumps are double acting plungers of 2½ inches diameter, designed to work at 40 revolutions per minute. The dynamo is placed in the engine room of the Linlithgow Oil Company, a distance of one and a quarter miles from the quarry, so that the power is transmitted electrically over 4,000 yards of cable. The cables are naked, and are carried by insulators on telegraph poles. The E.M.F. at the dynamo terminals is 250 to 300 volts, and the current 11 to 12 ampères, the output thus being 3,000 watts, or about 4 H.P., and a margin of 30 to 40 per cent. over present requirements has been allowed for future use. This installation is said to work very satisfactorily, and requires no attendant at the quarry. The last example given by the author is at the Allerton Main Collieries, near Leeds, where small pumps are used to deal with small quantities of water at the working places. They are worked from storage batteries, which are charged at the surface and taken to the pumps in the colliery tubs. This plant is also working in a satisfactory manner.

In treating of the employment of electrical plant for winding, reference is first made to the New Stassfurt Mine in Germany. In this case an inclined shaft was made at a slope of 40° to ascertain the depth of the potash salt bed. The mine is above 1,180 feet deep, and the engine at the surface is 520 feet from the shaft bank, whilst the winding gear is 130 feet from the shaft bottom. The total length of cable required was therefore about 607 yards. A Siemens dynamo giving a current of 22 ampères and 370 volts was already in the engine-house at the surface, having been used for some time for a small electric railway in the mine. Naked conductors ran to the shaft, and a covered cable placed in a wooden trough contained the connection to the shaft bottom and to the motor, which at the end of 1885 was erected for winding from the new inclined shaft. This was a Siemens motor running at 1,000 revolutions. It drove the winding drum by belting to an intermediate shaft and spur gearing. The work to be done was the lifting of a loaded tub weighing 24 cwts. and the lowering of an empty one weighing 7¾ cwts., through a vertical height of 328 feet on an inclined plane 500 feet long, once in four minutes. This required an effective power of 6 H.P. per minute as the useful work of the motor. The useful effect realised being 40 per cent., this required about 15 H.P. at the steam engine. The useful electrical efficiency realised was not less than 53 per cent. The machinery was in constant use without any hitch or accident until the end of March of last year, when the work for which it was established was completed.

The author next treated of haulage, and mentioned the large electric locomotive for underground haulage at the Short Mountain Colliery of the Lykens Valley Coal Company in Philadelphia. This was started in the autumn of 1887, and a second was built last September. The latter weighed about 13½ cwts., and had a 25 H.P. Schlesinger electro-motor driving by chain gearing. The current was supplied by a 50 H.P. Schlesinger dynamo at the surface, and conveyed to the motor by a ⊤ rail placed alongside the track on insulated posts about 20 inches above the ground level. From this rail the conductors, with several rolling contacts, carried the current to the motor, the track rails being used for the return part of the circuit. The track is 6,300 feet long, and the locomotive hauls daily, at from 6 to 8 miles an hour, about 500 tons. At Veteran Tunnel, Aspen, Colorado, three sets of rope haulage drums are working with 10 H.P. Sprague motors. These draw six trains, at the rate of 500 feet per minute, up a 3 per cent. gradient. An electric locomotive is working in the New Stassfurt (Germany) Salt Mines, and one also at the Salzberg Works.

Mr. Rowan then referred to the electric haulage plant at the Newcastle Exhibition two years ago, and stated that since that time this application of electricity had made some progress. He said that two installations of electrical haulage plant by fixed motors were about to be started. One is a 50 H.P. plant at Messrs. Locke and Co's. (who have already been referred to in connection with pumping by electricity), and the other is a 20 H.P. plant at Messrs. Partridge, Jones & Co., at Pontypool. Some details concerning these two installations are promised to be shortly given by the chief electrician of Messrs. Immisch, who are the makers of the electrical machinery. The author referred to the first self-contained electrical locomotive, which was designed by Mr. Reckenzaun for the Trafalgar Colliery, after which he gave some particulars concerning a locomotive designed by Mr. G. Blake Walker, of the Wharncliffe Silkstone Colliery—in conjunction with Messrs. Immisch. Both in America and in England have trials been made in applying electricity to the work of coal getting. The English machine has been patented by Messrs. Bower and Blackburn, of the Allerton Main Collieries at Woodlesford, assisted by Mr. Mori. At Silvertown, Idaho, a Sprague motor is employed at a mine to drive a 50 stamp mill four miles from the waterfall, which by means of a turbine drives a dynamo giving out 75 H.P. The manager of the mill claims to save £18 a day in the haulage of the ore. In conclusion, he gave another instance in America, viz., that at Big Bend Tunnel Camp, Butte County, California. In this case the Feather River is diverted into a tunnel 2½ miles long, and then into a canal 2 miles in length. By this means a fall of 300 feet is obtained and powerful Pelton waterwheels are fixed, driving Edison dynamos. The working E.M.F. is 1,000 volts, and current is delivered at 14 different points, the distance traversed by the conductors being 18 miles. About 20 Sprague motors varying from 5 to 50 H.P. are worked by branch conductors from these various stations, the potential at the motors being between 500 and 700 volts.

The discussion of the paper was postponed till the next meeting of the Institute, which took place in Glasgow on Thursday last week. As, however, nothing of importance transpired during the discussion, we do not think it necessary to reproduce it.

## THE BERNSTEIN SYSTEM OF ELECTRIC LIGHTING.

OUR readers are quite familiar with the Bernstein incandescent lamps and their working, but some recent improvements have been made which we briefly summarise as follows:—The latest form of lamp for series lighting is shown in the annexed fig. 1. The light-giving body, *a*, has the form of a straight carbon rod, which is attached to the ends of the leading-in wires, *b* and $b^1$; these wires are bent in such shape as to almost approach each other at the point *c*. *d* and $d^1$ are two sleeves of insulating material which surround the leading-in wires; these sleeves are pressed towards each other by means of a spiral spring *e*. Now, as long as the carbon is intact, the carbon rod itself prevents an approach of the two leading-in wires. But as soon as a flaw in the carbon should appear, and the rod be gradually destroyed at this place through the action of the current, the spring *e* commences to slowly press the leading-in wires together, until a perfect contact is produced in *c*, and then a short circuit is obtained inside of the lamp. Apart from the great simplicity and absolute security of the action, this construction has the great advantage that the formation of an arc inside of the lamp with all its accompanying disadvantages, is entirely avoided. These lamps are generally made from 16 to 50 candles. If it is desired to use a larger candle-power, as, for instance, in the lighting of squares, it is best to group several 50 candle-power lamps in one lantern. This is more preferable than the application of a single very large candle-power lamp, as these lamps are generally not so durable as those of a medium candle-power; and furthermore, the failure of one lamp would extinguish the total light in the lantern. In order to prevent the interruption of the circuit by the removal of a lamp out of its holder, this latter is constructed in such a way that the lamp can only be withdrawn from the holder if a short-circuit has been made in the holder beforehand; and, furthermore, the current can only be turned on after a lamp has been placed into the holder.

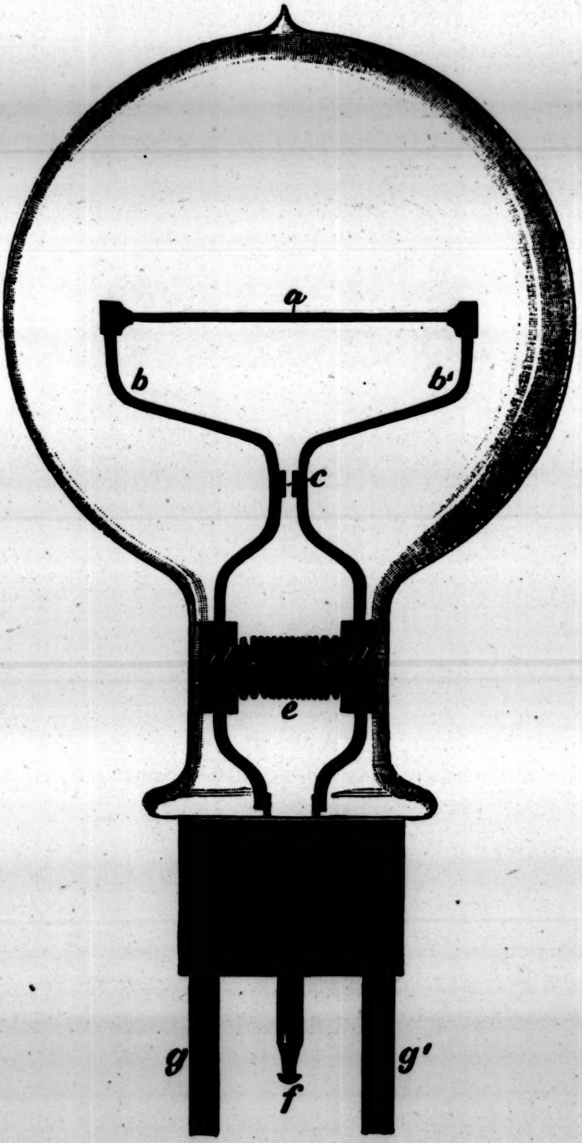

FIG. 1.

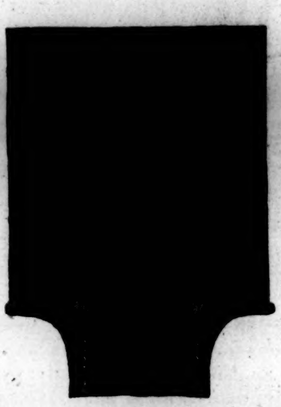

FIG. 2.

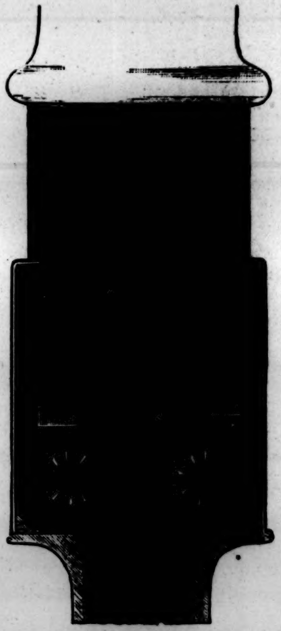

FIG. 3.

The holder is shown in the annexed figs. 2 and 3. A plate of insulating material, *h*, serves for the support of two metal sleeves, *i* and $i^1$, which are made suitable for the reception of the two square pins, *g* and $g^1$, of the lamp cap. For the purpose of obtaining a good contact between the pins and the sleeves, the outward side of the latter is replaced by two flat springs, *k* and $k^1$. The conducting wires are attached to the lower ends of the sleeves. The S-shaped piece, *m*, which can be turned by means of a handle, serves the purpose of making a short circuit in the holder. In the drawing, fig. 2, the position of short circuit is indicated. For the purpose of obtaining a good contact between the piece *m* and the metal sleeves *i* and $i^1$, the latter are provided with two other flat springs, of which the one on the left side, *k*, is bent at right angles at its lower end. The spring $k^1$ carries at its lower end a square pin, which prevents the turning of the piece *m* in the other direction. Under these circumstances the circuit cannot be opened. But if a lamp is placed into the holder, the two springs *k* and $k^1$ are slightly pressed outwards, and the square pin on $k^1$ comes out of the region of the motion of *m*; therefore *m* can be turned into the position shown in fig. 3, and in this case the current will pass through the lamp. It will be observed that the lamp cannot be moved out of the holder when the current is turned on, because the S-shaped piece, *m*, prevents the withdrawal of the lamp-cap on account of the peculiar form of the pin, *f*. If it is desired to remove the lamp, the piece *m* must first be turned in the position shown in fig. 2.

Although every holder is provided with a short-circuiting handle, it is often desirable to extinguish a whole group of lamps. In this case an ordinary short-circuiting switch can be used.

An ampèremeter should be placed into the circuit close to the dynamo.

These items constitute all the parts of this very simple system of incandescent lighting.

## MR. NIKOLA TESLA ON ALTERNATING CURRENT MOTORS.

THE following letter has been addressed to the New York *Electrical World*:—About a year ago I had the pleasure of bringing before the American Institute of Electrical Engineers the results of some of my work on alternate current motors. They were received with the interest which novel ideas never fail to excite in scientific circles, and elicited considerable comment. With truly American generosity, for which, on my part, I am ever thankful, a great deal of praise through the columns of your esteemed paper and other journals has been bestowed upon the originator of the idea, in itself insignificant. At that time it was impossible for me to bring before the Institute other results in the same line of thought. Moreover, I did not think it probable—considering the novelty of the idea—that anybody else would be likely to pursue work in the same direction. By one of the most curious coincidences, however, Prof. Ferraris not only came independently to the same theoretical results, but in a manner identical almost to the smallest detail. Far from being disappointed at being prevented from calling the discovery of the principle exclusively my own, I have been excessively pleased to see my views, which I had formed and carried out long before, confirmed by this eminent man, to whom I consider myself happy to be related in spirit, and towards whom, ever since the knowledge of the facts has reached me, I have entertained feelings of the most sincere sympathy and esteem. In his able essay Prof. Ferraris omitted to mention various other ways of accomplishing similar results, some of which have later been indicated by O. B. Shallenberger, who some time before the publication of the results obtained by Prof. Ferraris and myself had utilised the principle in the construction of his now well known alternate current meter, and at a still later period by Prof. Elihu Thomson and Mr. M. J. Wightman.

Since the original publications, for obvious reasons, little has been made known in regard to the further progress of the invention; nevertheless the work of perfecting has been carried on indefatigably with all the intelligent help and means which a corporation almost unlimited in its resources could command, and marked progress has been made in every direction. It is therefore not surprising that many, unacquainted with this fact, in expressing their views as to the results obtained, have grossly erred.

In your issue of May 4th I find a communication from the electricians of Ganz & Co., of Buda Pesth, relating to certain results observed in recent experiments with a novel form of alternate current motor. I would have nothing to say in regard to this communication unless it were to sincerely congratulate these gentlemen on any good results which they may have obtained, but for an article, seemingly inspired by them, which appeared in the London ELECTRICAL REVIEW * of April 26th, wherein certain erroneous views are indorsed and some radically false assertions made, which, though they may be quite unintentional, are such as to create prejudice and affect material interests.

As to the results presented, they not only do not show anything extraordinary, but are, in fact, considerably below some figures obtained with my motors a long time ago. The main stress being laid upon the proportion between the apparent and real energy supplied, or perhaps more directly, upon the ratio of the energy apparently supplied to, and the real energy developed by, the motor, I will here submit, with your permission, to your readers, the results respectively arrived at by these gentlemen and myself.

| Energy apparently supplied in watts. | | Work performed in watts. | | Ratio of the energy apparently supplied to the real energy developed. | |
|---|---|---|---|---|---|
| Ganz and Co. | Westinghouse Co. | Ganz and Co. | Westinghouse Co. | Ganz and Co. | Westinghouse Co. |
| 18,000 | 21,840 | 11,000 | 17,595 | 0·611 | 0·805 |
| 24,200 | 30,295 | 14,600 | 25,365 | 0·603 | 0·836 |
| 29,800 | 43,624 | 22,700 | 36,915 | 0·761 | 0·846 |
| ... | 56,800 | ... | 48,675 | ... | 0·856 |
| ... | 67,500 | ... | 59,440 | ... | 0·88 |
| ... | 79,100 | ... | 67,365 | ... | 0·851 |

If we compare these figures we will find that the most favourable ratio in Ganz & Co.'s motor is 0·761, whereas in the Westinghouse, for about the same load, it is 0·836, while in other instances, as may be seen, it is still more favourable. Notwithstanding this, the conditions of the test were not such as to warrant the best possible results.

The factors upon which the apparent energy is mainly dependent could have been better determined by a proper construction of the motor and observance of certain conditions. In fact, with such a motor a current regulation may be obtained which, for all practical purposes, is as good as that of the direct current motors, and the only disadvantage, if it be one, is that when the motor is running without load the apparent energy cannot be reduced quite as low as might be desirable. For instance, in the case of this motor the smallest amount of apparent energy was about 3,000 watts, which is certainly not very much for a machine capable of developing 90 H.P. of work; besides, the amount could have been reduced very likely to 2,000 watts or less.

On the other hand, these motors possess the beautiful feature of maintaining an absolutely constant speed no matter how the load may vary. This feature may be illustrated best by the following experiment performed with this motor. The motor was run empty, and a load of about 100 H.P., far exceeding the normal load, was thrown on suddenly. Both armatures of the motor and generator were seen to stop for an instant, the belts slipping over the pulleys, whereupon both came up to the normal speed with the full load, not having been thrown out of synchronism. The experiment could be repeated any number of times. In some cases, the driving power being sufficient, I have been enabled to throw on a load exceeding eight to nine times that which the motor was designed to carry, without affecting the speed in the least.

This will be easily understood from the manner in which the current regulation is effected. Assuming the motor to be running without any load, the poles of the armature and field have a certain relative position which is that of the highest self-induction or counter electromotive force. If load be thrown on, the poles are made to recede; the self-induction or counter electromotive force is thereby diminished and more current passed through the stationary or movable armature coils. This regulation is very different from that of a direct current motor. In the latter the current is varied by the motor losing a certain number of revolutions in proportion to the load, and the regulation would be impossible if the speed would be maintained constant; here the whole regulation is practically effected during a fraction of one revolution only. From this it is also apparent that it is a practical impossibility to throw such a motor out of synchronism, as the whole work must be done in an instant, it being evident that if the load is not sufficient to make a motor lose a fraction of the first revolution it will not be able to do so in the succeeding revolutions. As to the efficiency of these motors, it is perfectly practicable to obtain 94 to 95 per cent.

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* Mr. Tesla is correct in assuming that the statements in this article were made upon the responsibility of Messrs. Ganz & Co. —EDS. ELEC. REV.

The results above given were obtained on a three-wire system. The same motor has been started and operated on two wires in a variety of ways, and although it was not capable of performing quite as much work as on three wires, up to about 60 H.P. it gave results practically the same as those above-mentioned. In fairness to the electricians of Ganz & Co., I must state here that the speed of this motor was higher than that used in their experiments, it being about 1,500. I cannot make due allowance for this difference, as the diameter of the armature and other particulars of the Ganz & Co. motor were not given.

The motor tested had a weight of about 5,000 lbs. From this it will be seen that the performance even on two wires was quite equal to that of the best direct current motor. The motor being of a synchronous type, it might be implied that it was not capable of starting. On the contrary, however, it had a considerable torque on the start, and was capable of starting under fair load.

In the article above referred to the assertion is made that the weight of such alternate current motor, for a given capacity, is "several times" larger than that of a direct current motor. In answer to this I will state here that we have motors which with a weight of about 850 pounds develop 10 H.P. with an efficiency of very nearly 90 per cent.; and the spectacle of a direct current motor weighing, say, 200 to 300 pounds, and performing the same work, would be very gratifying for me to behold. The motor which I have just mentioned had no commutator or brushes of any kind, nor did it require any direct current.

Finally, in order to refute various assertions made at random, principally in the foreign papers, I will take the liberty of calling to the attention of the critics the fact that since the discovery of the principle several types of motors have been perfected and of entirely different characteristics, each suited for a special kind of work, so that while one may be preferable on account of its ideal simplicity, another might be more efficient. It is evidently impossible to unite all imaginable advantages in one form, and it is equally unfair and unreasonable to judge all different forms according to a common standard. Which form of the existing motors is best, time will show; but even in the present state of the art we are enabled to satisfy any possible demand in practice.

**NIKOLA TESLA.**

Pittsburgh, Pa.

## A SYNTHETIC STUDY OF DYNAMO MACHINES.

(*Continued from page* 594.)

### VI.—ARMATURES IN PRACTICE—(*continued*).

ENTERING the region of actual machines, we give in fig. 106 a sectional sketch through the magnets of the Thomson-Houston dynamo for arc lighting. It will be seen that the arrangement for producing the field of this machine differs considerably from anything yet described. The magnet consists of two cast iron flanged tubes, B, B, the inside ends of which are partially closed and hollowed out to a cup-shape to receive an armature externally resembling a sphere. The poles of the magnet are formed by these cup-shaped cavities. Between the flanges on the outside ends of the tubes are wrought iron bars, A, A, which form collectively the yoke to the magnet. A magnetising coil is wound on the outside of each tube as shown.

It may be here pointed out that, disregarding the waste field, it is immaterial on what part of the magnetic circuit the magnetising coils are wound. Thus on the double magnetic circuit, sketched in fig. 107, there may be two coils, one on the part A, and another on the part B, or the two may be placed instead, one on C and another on D; or, again, instead of two coils four may be employed, these being placed on the parts L, M, N and P. The object is to induce a field in the core of the armature, and were it not for the mechanical difficulties involved, the best place for the magnetising coils would undoubtedly be where they enclose the armature itself or surrounding the parts C, E, D, in the fig. The fields of some dynamos are actually obtained in this way, but wherever the coils are wound great care must be taken with the double-magnet types to have exactly the same magnetising force on each horse-shoe. In the single horseshoe magnet, fig. 108, there may be two magnetising coils, one on A and another on B, or one coil only placed at C, or coils on all these parts. If it were possible, coils placed to surround the armature over the parts of the circuit, D, E, F, might be employed.

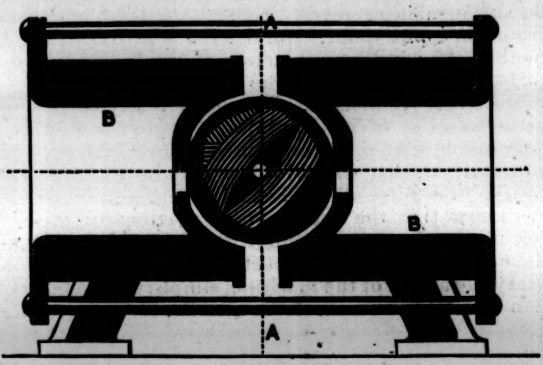

FIG. 106.

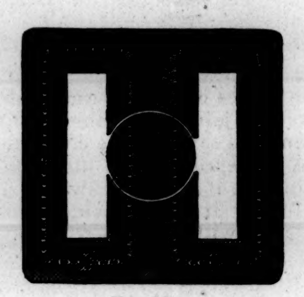

FIG. 107.

But, returning to the Thomson-Houston machine, it is in the armature that the chief peculiarity lies. The frame carrying the iron core is formed by keying on a shaft two cast iron concave plates, and connecting them together at the rims by light ribs of wrought iron stretching between them. Over these ribs is wound the varnished soft iron wire which constitutes the core, and over this the armature coils are wound. The latter are three in number, wound over the core at angles of 120° to each other, and nearly

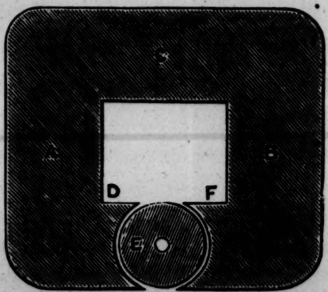

FIG. 108.

covering the whole surface of the armature, as shown in fig. 106. All the coils are connected at one end, their other ends being brought to three separate metal segments, having each an angular width of about 120°, and which, when mounted end to end on an insulating piece, are separated by small gaps from the commutator. In fig. 109 is a diagram of the method of winding. A, B and C are the commutator plates; and $A_1$, $B_1$ and $C_1$ the coils with which they are respectively connected. The coils really consist of a great number of convolutions, though, for simplicity, only one is shown, the separate coils being black, white, and hatched, that the winding may be followed more easily. They are all connected together at one end, D. We know that the induction in portions of the same coil diametrically opposite will be combining to send the current in the same direction, so we can, in order to study the action of the machine, simplify the representation of coils and commutator as in fig. 110. Here $A_1$, $B_1$ and $C_1$ are the planes of the three armature coils, whose inside ends are joined together at D, and their free ends connected to the three commutator segments. The lines, N, N, represent the direction of the field, the dotted line, $D_1$, $E_1$, being drawn at right angles to the lines of force. It will be evident that a coil when its plane coincides with this line will be adding nothing to the E.M.F. of the machine, for then the movement of the conductor is parallel to the direction of the field, but in any other position the coil is active, the position of maximum activity being that in which the plane of the coil is parallel to the direction of the field, and the active parts, therefore, cutting the lines, N, N, at right angles. The current is collected by four copper plates, P, Q, R, and S, which are connected together in pairs as shown. These connections make the arrangement equivalent to that of two brushes having a width equal to the length of the segment lying between the connected plates, or equal to an angular width of 60° under normal conditions of working. From the junctions at F and G the current is led through the field magnets and a current regulator to the lamp circuit. Since each brush has an angular width of 60° there is between the positive and negative brushes an angle of 120°, which is equal, neglecting the small air gap, to the width of one commutator segment. It follows from this that from the time one segment touches till it leaves a brush the armature must rotate through 180°, or make exactly half a revolution. Under normal conditions, then, each segment must be always in contact with one brush or the other, and the contact is changed at the moment of reversal, or when no E.M.F. is being induced in the coil with which the particular segment is connected. In fig. 110 the coil, $A_1$, is shown in the position of reversal, and just changing over from the left hand to the right hand brush. For 60° onwards from the position shown, $A_1$ is in parallel with $B_1$, these two being in series with $C_1$. For the next 60° A alone is in contact with the right hand brush, but it is in series with $B_1$ and $C_1$, which are in parallel. For the remaining 60° of the half revolution $A_1$ is in parallel with $C_1$, and the two are in series with $B_1$. Thus for one-third of the time during which a segment is under one brush, its coil is parallel with the one in front of it, for one-third it is in series with the other two which are in parallel, and for one-third it is in parallel with the one behind it. The segment then coming in contact with the other brush, the changes are repeated. We shall return to this machine again and explain its action more fully, but for the moment we must be content with the description here given of the armature winding and its connections to the commutator.

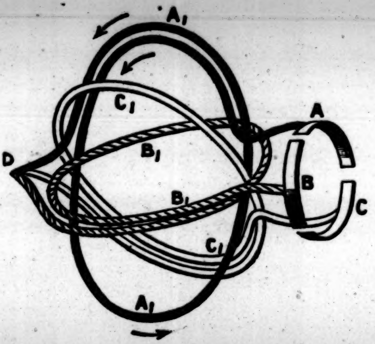

FIG. 109.

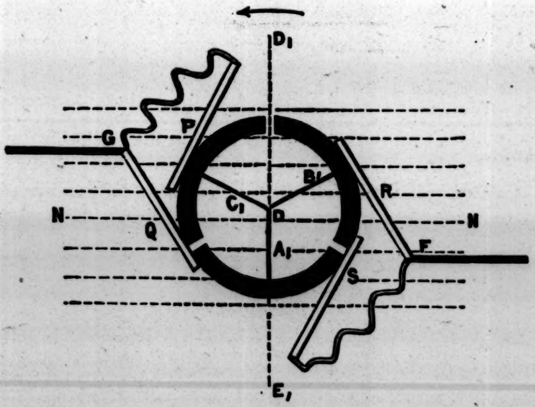

FIG. 110.

(*To be continued.*)

## GASTON PLANTÉ.

IN our last issue we briefly referred to the death of this *savant*, now we offer a short sketch of his life and work. M. Planté was born in 1834, and educated at the Conservatoire des Arts et Metiers in Paris, where he became assistant to M. Ed. Becquerel. He interested himself especially in the study of voltameters which were constructed of a variety of materials, and he noted the effects with admirable exactness, drawing from his observations those accurate conclusions which formed the basis of all modern secondary batteries, of which he was incontestably the inventor. All the most important experiments, which occupied M. Planté during a period of twenty years (between 1859 and 1879), originally appeared in "Notes" in *Comptes Rendus*, and were later republished in book form under the title *Recherches sur l'électricité*. An English translation, by Mr. P. B. Elwell, of this important work was published by Messrs. Whittaker and Co., of London, two years ago. This work comprised the accumulation and transformation of the energy of the voltaic battery by means of secondary currents, leading up from the results obtained with various voltameters to the numerous practical applications of the secondary batteries, with suggestions which have since been taken advantage of by hundreds of inventors, many of whom have probably never read the writings of this great man. Among these suggestions of Planté will be found galvanocaustic applications; the lighting of dark cavities in the human body; firing mines; electric brakes for use on railways; eudometric analysis of the atmosphere in mines; the production of luminous signals; the subdivision of the electric light, and many other industrial uses of secondary batteries. His studies of the effects produced by electric currents of high tension (in those days only obtainable by means of secondary batteries) teem with discoveries and demonstrate the versatility of a comprehensive intellect. M. Planté drew comparisons between electric phenomena in the atmosphere, and those which he obtained by means of powerful currents from accumulators, and so recently as 1888 he published in the

*Bibliothèque Scientifique Contemporaine* a complete synthesis on the effects of lightning, hail-storms, and the aurora borealis.

In 1881 M. Planté received the Diplome d'Honneur at the Paris Electrical Exhibition, and he was also made a Chevalier and Officer of the Légion d'Honneur.

At the last meeting of the Academie M. Berthelot expressed his deepest regret that Planté has not been elected a member of this great Society. He never sought any honours, but when these were showered upon him during the last few years he did not change his retired habits, nor did they affect his modest and genial character. His loss will be deeply regretted by all who knew him or of him, in his native country or abroad. Generous to the last, he willed his property at Bellevue, near Sevres, to be turned into an asylum for the retirement of poor scientists (*savants*), and he instituted a biannual prize of 3,000 francs for the author of any new discovery in electricity.

## HOPES AND FEARS.

NO doubt most of our readers have seen the letters written to two of the leading daily papers by Major Flood Page and Professor Thompson, with reference to Major Marindin's report to the Board of Trade on the Electric Light Commission. Dealing first with Prof. Thompson's letter, whilst agreeing with him up to a certain point in theory as to the advantages of a storage system, we confess candidly we do not take such a pessimistic view as he does of the alternating system. The friends of storage systems are to be congratulated on having such an able champion, but we would, however, remind Prof. Thompson and them that Major Marindin had other points to consider in meting out the different districts to be lighted, quite apart from actual systems *only*; as, for instance, capital, vested interests, localities for central stations already acquired, giving the owners the advantage of being able to commence supplying current at once, a very important consideration in certain places. Then placing the assertions of the friends of the alternating systems against those of Prof. Thompson, we find the one relying upon duplicate plant, with plenty of reserve power to provide a constant and unfailing supply of current, and the other on storage with a *limited* supply in hand. Weighing the one against the other, we really do not see that the public need fear a worse service from the first than the second. Prof. Thompson has not seen, any more than the rest of the world, actual house-to-house and street lighting on a really general scale, and doubtless, as the tremendous work of supplying London with electric light throughout is started in earnest, capital will be forthcoming that will enable the laying of mains and service wires, &c., to be carried on in a way and with a thoroughness that he, perhaps, has not given himself time to fully appreciate. Again, has not Prof. Thompson's outcry against a system that cannot be utilised during the daytime for motive power been a little premature? We think that may be Mr. Mordey will have something further to say on this subject which will allow the alternating system companies to take heart of grace and hold their heads quite as high as their storage brethren.

Professor Thompson makes a great point of what he considers the wrong construction put upon the statement "that the alternating system is essentially applicable to *large* areas." He takes this to mean scattered areas sparsely built upon; the report renders it densely populated. Repeating what we averred a fortnight ago, that the report is an utterly unbiassed one, we think that this letter of Prof. Thompson's to the *Times* is a further proof of it; all the competitors are dissatisfied to a certain extent, and Major Marindin may take this dissatisfaction as a compliment, and a recognition by all concerned, of his ability as arbitrator.

Prof. Thompson flounders about in a glorious muddle over the exceptions he takes to Mr. Calcraft's letter; if that of the latter be "curiously contradictory," the one of the former is ten times more so. The sound principle of 1883 is not in effect departed from at all, as the Professor admits when he says the letter "reduces the principle of competition to a mere farce." Precisely! Mr. Calcraft shows that as long as the public are properly served, there will *not* be competition; he and Prof. Thompson are, therefore, entirely of one mind in that. The ultimate conclusion arrived at by the Principal of the Finsbury Technical College is that the report is "illogical, lame, and unfair;" had it been in favour of larger grants of district to the smaller storage supply companies, a far more copious torrent of wrathful regrets at the result would have been showered on Major Marindin's devoted head.

It is refreshing to turn from Prof. Thompson's strictures in the *Times* to Major Flood Page's satisfaction in the *Standard*. The latter from a very practical point of view surveys the position of electric lighting from a purely commercial standpoint. We cordially endorse Major Flood Page's statement that "no body of men are yet sufficiently acquainted with the development that electric lighting will take, to draft an unalterable model order." There is no doubt that the local authorities who wish to undertake the lighting of their own districts will have to show that their intentions will be carried out; provision for private enterprise to step in in the event of their not doing so has been made, so that Major Flood Page's fears on this score are groundless.

Has not the gallant Major misread the report with regard to the minimum annual amount payable by the consumer? The maximum could only be based on a price per lamp per annum, whereas the minimum protects the supplier in cases where the light required is on a very small scale.

We are very glad to see a subject of such importance is being ventilated by such well-known men as Prof. Thompson and Major Flood Page, for the fears of the one and the hopes of the other are a true guide to the state of anxiety of the scientist and the aspirations of the promoter.

## LIGHTNING CONDUCTORS.

By S. ALFRED VARLEY.

(*Continued from page* 622.)

THE observations of Andrew Crosse go to show that charged clouds are arranged in layers separated by atmospheric air, which forms the dielectric of a series of Leyden arrangements.

These Leyden arrangements arrange themselves by electric attraction, and when the potential is high enough to break down the dielectric, discharge occurs, such discharge taking place sometimes between the clouds themselves only, and at other times between the upper regions and the earth.

The famous experiments of Wheatstone with the revolving mirror demonstrate that an electric discharge commences *simultaneously* at the *two ends* of a path of discharge, and terminates at the centre.

Wheatstone, it will be remembered, employed in these experiments two coils of insulated wire, whose total length was half a mile. These coils were so arranged with respect to the Leyden jar that there were three air spaces in the path of discharge, one in the centre dividing the coils from one another, and the two others separating the extremities of the insulated wire from the + and − coatings of the Leyden jar respectively.

When discharge occurred, the electricity leaped through the three air spaces, and the three sparks produced were observed in the mirror revolving at the enormous speed of 800 revolutions in a second. Wheatstone does not appear to have fully comprehended the consequences of what he observed, but he made the following most important observations :—

1. That when a Leyden jar discharge occurred through a space of air only, the duration of such discharge did not exceed the one millionth of a second.

2. That when the insulated wire was interposed in the circuit the sparks at both extremities were observed in the mirror to occur simultaneously, and the central one a little later, demonstrating that the + and — discharges commence at the same time and travel towards one another, meeting in the centre.

3. That the speed with which the electric impulse travelled through the wire was at the rate of 288,000 miles per second, and that the duration of the act of discharge when the half-mile of wire formed a portion of the path of dischage, was increased from the one millionth to the twenty-four thousandth part of a second.

Had Wheatstone repeated his experiments with Leyden jars of greater and varying capacity, and with lengths of insulated wire of varying lengths, he would have observed that either increasing the capacity of his Leyden jar or the length of wire interposed would have prolonged the act of discharge, and reduced the rate of speed at which the electric impulse travelled. Long submarine cables, which are really Leyden arrangements of enormous capacity, having metal paths of great length and considerable resistance, have rendered electricians familiar with what Wheatstone only saw indications of.

Prof. Lodge has repeated Wheatstone's revolving mirror experiments with Leyden arrangements of very large capacity and with circuits of varying resistance, and by so doing he has prolonged the act of discharge and reduced the rate of flow considerably.

When a Leyden jar discharge occurs through the atmosphere the air acts the part of a conductor. Its resistance is infinitely greater than a metallic conductor when time is given; but as atmospheric air possesses, relatively to metallic conductors, very little magnetic inertia, the duration of the act of discharge through air, as Wheatstone has shown, is less than through a metallic path of discharge. What I wish, however, to lay stress more particularly upon is that a discharge through air commences to flow at the two extremities, meeting in the centre. Wheatstone's experiment may be fairly considered, I think, not to allow any doubt on this point. That being so, it naturally seems to follow that if such discharge be observed in a mirror revolving at a sufficiently high velocity relatively to the speed the electric impulse is travelling, the sparks will appear in the mirror broken up into a number of beads, and therefore Prof. Lodge's revolving mirror experiment, where Leyden jar discharges through air (whose rate of speed was largely reduced by the employment of Leyden arrangements of great capacity and the interposition of very considerable magnetic inertia), were observed to be resolved into beads, cannot be regarded as evidence that Leyden jar discharges are oscillatory. On the contrary, what was seen would seem to be the natural corollary of what Wheatstone has taught us.

Leyden jar discharges are crooked and of irregular shape; were they not so, one would expect to see in the revolving mirror a curved series of beads.

If Wheatstone's experiments were repeated, and the central air space between the two coils bridged across by a very fine platina wire stretched as straight as possible, leaving the air spaces between the + and — coatings of the Leyden jar as in Wheatstone's own experiments, the platina wire would guide the discharge and be deflagrated and converted into gas by the act of discharge, and if the incandescent wire in the act of deflagration were observed in the revolving mirror, I venture to predict a curved series of beads or a curved line would be observed; and whether it was seen as a curved line or resolved into beads would depend on the ratio of the velocity of the mirror to the speed of the electric impulse, whose rate can be retarded or quickened by increasing or decreasing the magnetic inertia encountered in its passage.

In performing the Wheatstone experiment, as above suggested, with the central air space bridged over by very fine platina wire it would be advisable to reduce the rate of speed of the electric discharge by the employment of Leyden arrangements of great capacity, and the interposition of a conductor having considerable magnetic inertia in the manner Prof. Lodge has already done in his experiments.

When thinking over Wheatstone's experiments the question naturally suggested itself, how is it that discharge commences at the two extremities of the path? If a weight be hung from a chain every link is put under stress, and a similar state of things prevails in a dielectric or a conductor at the moment preceeding conduction.

Most, if not all, of our older electricians believed, 1st, that a uniform stress throughout the path preceeded the act of discharge; and 2nd, that a transference of the electric forces through a conductor occurred in every part of it, at one and the same time. Wheatstone has, however, shown us this is not so.

I proceed to consider the mechanism of a Leyden jar discharge, and to suggest an explanation of what Wheatstone has demonstrated, but which, as far as I know, neither he nor anyone has hitherto attempted to explain.

When two conductors, separated by a space of air, are charged + and — respectively, induction takes place through the air dividing them, such induction proceeds from the oppositely charged conductors to the molecules of air in their immediate neighbourhood; these molecules transmit the induction to those immediately contiguous to them, and these again perform the same office to those in their immediate neighbourhood, a progressively greater number of molecules being brought under the inductive influence until the two sets of induced molecules meet one another. In fact there are formed two cones of induced molecules radiating from the oppositely charged conductors, whose bases are situated midway between the + and — inducing conductors.

Now, it is evident that the potential of the individual molecules of the dielectric air brought under inductive influence is less, as the surface over which they are spread and the number of them embraced becomes greater, and, therefore, the molecules at the apexes of the two cones in the immediate neighbourhood of the + and — charged conductors may be at the breaking down point at the same time as the molecules spread over the larger surface midway, may be under a moderate strain only. That being so, the molecules close to the two conductors give way first, and their breaking down involves raising the potential of the layer of molecules immediately in advance of them, and so on, until the opposite electricities meet in the centre. Time, however, is involved in this breaking down of the molecules of the successive layers, because the potential of the molecules, as they approach nearer and nearer to the centre, is less directly as their surfaces are greater, and the potential has to be raised until there be sufficient force to break down the dielectric; so a Leyden jar discharge through air would appear to proceed by stages, a series of short discharges following rapidly on the heels of one another and occupying time.

The following illustration will perhaps render the above explanation clearer. Construct a condenser of a series of glass plates of equal thickness and size. Let these plates be, say, 18 inches square. Coat the central plate on both sides with sheets of tinfoil in the centre of the plate, and let these coatings be, say, 12 inches square, place glass plates on either sides of the central plate, and coat these plates on their outer sides with tinfoil, say 8 inches square, place glass plates over these again, and coat them on the outer sides with tinfoil, say 4 inches square. By this mode of construction a condenser will be produced with metallic coatings gradually reducing in surface from the central plate, resembling but very imperfectly the double cone of air molecules brought under the influence of induction when an air space separates oppositely-charged conductors.

Connect the outer coatings of the above condenser with the + and − poles of a large influence machine and proceed to charge it; induction will occur throughout the whole mass, and all the glass plates will be subjected to electrical stress, but owing to the greatly reduced surface of the tinfoil coating on the two outside plates, the stress to which these two plates will be subjected is much greater than that of the interior ones, because the force is concentrated over a smaller number of the molecules of glass; continue to charge until the + and − potentials are sufficient to break down the dielectric, the two outside plates will give way, and the two intermediate plates will now receive + and − charges; but as the tinfoil coatings of these plates are of considerably greater surface than those of the outside plates, the potential to which they will be charged will be less than that which broke through the outer plates. Continue to charge, and when the potential has been raised sufficiently the two intermediate plates will give way and the central plate will now receive a charge; but as the surface of the coatings of this central plate is very much larger than that of the plates next to it, the potential of the charge will be correspondingly reduced, and to break it down further charging will be required.

We have a further illustration of the mechanism of an electric discharge when it takes place from a conductor of small sectional area through the air. Induction occurs through layers of air molecules in the form of an inverted cone; the higher potential of the smaller number of molecules in the immediate neighbourhood of the conductor being sustained or balanced by a series of layers of molecules of increasing surface and of a potential decreasing directly as their surface increases. When the potential of the molecules near the apex of the cone becomes raised high enough to break them down, the next layer becomes charged and broken down so soon as the potential has been raised sufficiently, and so on through the succession of layers of increasing surface until the number of molecules embraced is so great that the air may be considered as a conductor, or air currents are set up, the molecules then playing the part of carriers assisted by the moisture and matter suspended in it. It must not be overlooked that a statical charge is not in the metal coatings of a Leyden arrangement, they serve simply to distribute the potential uniformly over the surface of the dielectric, and to assist bringing about rapid discharge afterwards.

Faraday regarded all dielectrics as more or less conductors, and atmospheric air may be considered as a conductor of practically infinite sectional area and of practically almost infinite resistance; conduction through it occurring only, by a breaking down of its organisation.

A metal conductor differs from a dielectric, considered as a conductor in the fact that the number of molecules brought under electric stress is uniform throughout the whole length, and when considered as a dielectric it differs from the more perfect dielectrics (more especially when of large sectional area) in the fact that the potential or stress is practically uniform throughout.

If it be admitted that Sir Charles Wheatstone correctly reported what occurred when a Leyden jar discharge was observed in a rapidly revolving mirror, and I think no one will venture to doubt it, then what has been said above in reference to what was observed by Professor Lodge in his revolving mirror experiments and also in respect to the mechanism of a Leyden jar discharge seems to follow as a logical consequence of common sense reasoning, and to my mind it amounts to a positive demonstration that Leyden jar discharges through air are not oscillatory.

In the continuation of this article I purpose saying a few words on Leyden arrangements.

(*To be continued.*)

## NOTES.

**Electric Light in Havana.**—A Spanish American Company is establishing a central station at Havana. Westinghouse dynamos will be employed. The glow lamps number 1,500, and Waterhouse arc lamps of 2,000 C.P. will also be used.

**Theatre Lighting in Spain.**—A new electrical journal, *El Telegraphista Espanol*, published in Madrid, states that the installation of the Theatre de Maravillas, which was inaugurated six weeks ago, has proved very successful. Two Gülcher dynamos of 100 volts and 80 ampères are employed, driven by a 30 H.P. steam engine. There are 250 incandescent lamps of 10 to 16 C.P., and two arc lamps of 500 C.P.

**Theatre Lighting in Olmütz.**—The electric light has been installed in the Town Theatre of Olmütz. There are about 450 incandescent lamps employed within the building, and two arc lamps outside. There are 230 lamps on the stage, 140 in the auditorium, and 85 in the lobbies, dressing rooms, &c. Current is supplied from three Gülcher dynamos of 110 volts, each capable of feeding 400 glow lamps. These are placed in a mill belonging to Herr H. M. Passinger, and also furnish current for lamps in the mill, and to three restaurants and a brewery. Power is supplied by a steam engine or a turbine, as may be desired.

**Electric Lighting at the Paris Exhibition.**—Some hitches have occurred with the electric light, as is usually the case at the commencement of an Exhibition. The lights went out suddenly one night, leaving one side of the Champ de Mars in total darkness, and on one occasion the manager of one of the Exhibition theatres had to return the money owing to a failure of the light. All these little mishaps have, no doubt, been remedied by this time.

**Electric Lighting in Dublin.**—A deputation from the Dublin Corporation has visited Eastbourne for the purpose of inspecting the system of electric lighting in use here. After inspecting the lights on the sea front, they were met by the Mayor (chairman of the Eastbourne Electric Lighting Company). The "installation" at the Town Hall was, it is stated, greatly admired. The electric light works in Junction Road were also visited. The deputation included Mr. J. F. Beveridge (Town Clerk), Mr. Spencer Harty (borough surveyor, president of Institute of Civil Engineers, Ireland), Councillor John L. Robinson, Alderman Byrne, and Councillor Richard Toole.

**Opening for a Telephone Company.**—The *Gazetta de Madrid* announces that offers will be received up to the 28th inst. for installing and working a telephonic system at Havannah. The affair was put up before, but the undertaker did not deposit the necessary caution money within the stipulated time.

**Telephony in Spain.**—There are at present 30 urban telephonic systems in Spain with 4,585 subscribers. The subscription varies from 64s. to 240s. per year. Of these concessions 28 have been given to private persons and only two to companies. Of the latter, one, the Sociedad General de Telefonas, runs the Madrid system with 1,458 subscribers; the other, the Sociedad Espanola de Electricidad, is established in Barcelona with 775 subscribers. The Madrid Company paid a dividend of 10 per cent. on last year's working.

**Telephony in Germany.**—It has been arranged to connect Berlin and Chemnitz telephonically, and the system will also include Annaberg-Buckholz, Glauchau, Merane, Hohenstein-Ernstthal, Burgstädt, and Frankenberg-Hainichen. The names of these latter villages are rather of the jaw-breaking order, and it is to be hoped that the repetition of them will not damage the wires. Löwenberg, in Silesia, is also to be connected with Berlin.

**The Telephone in Servia.**—A Foreign Office report states that at Belgrade telephonic communication has been established during the past two years between the Palace, public offices, fortress, and barracks. The work has been mainly carried out by Messrs. Siemens and Halske.

**Telephone Amalgamation.**—Messrs. Carter & Carter, the eminent accountants of Birmingham, say that in their opinion the value of a share in the National Company, as at present constituted, is as great, if not greater, than a share in the United Company, and that the public have been giving about three times the price for one of two things which are about of equal value.

**The Telephone Companies.**—Mr. R. Chamberlain asked the Postmaster-General whether his attention had been called to the large amount of capital to be created under the new scheme for amalgamation and to the high charges that must be maintained for public user, or whether he intended to avail himself of the right to establish such a telephone system as would bring its advantages within the reach of the masses. He wished to call attention that this capital was a paper capital and not a real one. Mr. Raikes said: In reply to the hon. member, I have to state that I am aware of the proceedings of the telephone companies, and that the whole question of the telephonic service of the country is engaging my serious attention. I am not at all sorry that this question has been asked, as it may serve to direct public attention to a matter of extreme gravity, with regard to which expressions of public opinion may materially strengthen my department in protecting the public interest.

**Electrical Filtering of Greasy Oils.**—The question of greasy oils is one of those, says *Le Commerce*, which prove that there are no small economies in industry. It seems fit and natural to throw away oil which has become dirty, but when one takes into consideration his manufacturing accounts, &c., he will see that there is a relative waste which burdens manufacturing. This our engineers racked their brains to find a means of avoiding, and to recuperate, by special apparatus, the portion still utilisable of the lubricant which had already been used. Of course, the aid of electricity was called in, and this is what has taken place: An American, Mr. C. F. Dunderdale, has invented a process of electric filtration on the principles of which the Electric Filter Company works at Chicago. This process consists in causing the dirty oil to pass through a bed of iron turnings or filings, strongly magnetised by the aid of an electro-magnet. The mass of iron filings constitutes a sort of magnetic sponge, to which remain adherent all the dust which has soiled the oil, and principally iron dust, which becomes caught in the oil. With a view to lead to the return of the oil to its original purity, and for more safety, Mr. Dunderdale passes the oil thus treated through two sand filters under pressure, which completes the operation.

**Organ Playing by Electricity.**—The electric organs of St. Jacques de Haut Pas, Paris, have been inaugurated by the Cardinal Archbishop of Paris, who solemnly blessed them with all liturgical rites. M. Franck, professor of the organ at the Conservatoire, who took up his position at the keyboard, worked together and successively, by means of an electrical transmission, the chorus organ and the great gallery organ. Abbé Perraud delivered a stirring address, in which he eloquently set forth the *rôle* of the arts in our worship, for the good of man and the glory of God.

**An Opinion.**—The *Weekly Bulletin* waxes eloquent over the prospects of the St. James's and Pall Mall Electric Light Company, Limited. Here is a bait for investors:—"The works of the company are well worth a visit by those interested in the latest development of electric lighting in the metropolis. If the shares can be picked up at anything like par they are a bargain."

**Insult by Telephone.**—*Apropos* of the case of Poigny, the man who was accused of insulting M. Carnot through the medium of the telephone, but who has been acquitted, the *Figaro* has the following:—"Telephonic Communications—Professional Secret—It took a certain time to capture the man guilty of insulting the President of the Republic, for on two different occasions the telephone company, entrenching themselves behind professional secret, refused to give up to the police the name of the subscriber who had been put in communication with the Elysée. It was only to the formal order of M. Clément that the company gave way and furnished the required information."

**Postal Convention between France and the British Colonies.**—At a late sitting of the French Senate, the Bill was passed approving the convention relative to the interchange of post office orders between France and various British colonies through the intermediary of the London Post Office.

**Central Station at Prague.**—Messrs. Waldek and Wagner, of Prague, have received a commission from the town to establish a central municipal electric light station.

**South America.**—A central station to supply 30,000 Edison lamps is being erected at Buenos Ayres, under the superintendence of Mr. C. V. Boisot.

**Electrical Clocks.**—Monsieur André, of the Lyons Observatory, has reported very favourably on the system of electrical timepieces adopted in that town. A clock in the Town Hall is connected electrically with 67 dials in various districts, and during three months only three dials have for a short time been stopped.

**New Foreign Companies.**—At Hamburg a company has been formed with a capital of £500,000, under the style of the Glühlampenfabrik und Electricitätswerke, Hamburg. This has acquired the electrical businesses of Messrs. C. H. F. Müller, Basse and Klentze, and J. F. Klentze & Co.

**Dynamo for Demonstrations.**—Mr. de Meritens has constructed a new dynamo for lecture purposes. It can be worked by hand to light five glow lamps of 16 C.P.

**Steamer Lighting.**—The steamboats on the Seine, which correspond to the Thames penny boats, are lighted by electricity. A special steam engine of 4 or 5 H.P. is used driving a Breguet continuous current machine.

**Electrical Exhibition at Trient.**—The Municipality of Trient intend to erect by the end of the year a central station, from which current will be supplied for street and private lighting, and for transmission of power to public buildings and for private factories. The town has at command water power from the Fersinabach of 600 H.P. It is stated that glow lamps will be mainly employed for the street lighting. In order to demonstrate to the inhabitants the advantages of electricity, and the uses to which it can be put, the Municipality got up an electrical exhibition. At this various adaptations of the electric light have been shown, and a carpenter's shop, with the machinery driven by an electric motor, represented the power section of the industry. Subscriptions have been received for 1,000 lights and for 150 H.P.

**Electric River Navigation.**—The value of electric charging stations was demonstrated on Wednesday last, when the launch *Volta* made a river trip which could scarcely have been so successfully accomplished had it not been for the facilities of recharging at Platts Eyot (Immisch & Co.'s river headquarters). The *Volta* carried a distinguished party invited by Mr. Horace Sedger, the popular lessee of the Prince of Wales' Theatre, from Hampton Court to Chertsey and back to Richmond.

**Struck by Lightning.**—During the recent thunderstorm that passed over the city of Norwich, Edward Knights, landlord of the Waterman Tavern, King Street, was drawing some beer, when an exceedingly vivid flash appeared to strike the engines. Knight's right hand was affected as if a sharp penknife were drawn towards the shoulder. The flesh around the cut turned very black, and he lost for a time the use of his arm.

**Oh, Snakes!**—A German paper reports that a novel use of electricity has been made in India for the prevention of the intrusion of snakes into dwellings. Before all the doors and around the house two wires are laid, which are isolated from each other and connected with an induction apparatus. Should a snake attempt to crawl over the wires he receives a shock of electricity which either kills or frightens him into a hasty retreat. Mr. Edison, we believe, devised a somewhat similar arrangement for the extermination of black beetles.

**Electric Lighting in Swansea.**—Consent has been obtained from the Board of Trade to the application of the corporation of Swansea for power to light the borough by electricity.

**Electric Launches on the Thames.**—We understand that considerable progress is being made in the direction of adapting electric propulsion to the pleasure boats on the upper portion of the river. Mr. W. Sergeant, of Strand-on-the-Green, Chiswick, the designer and constructor of the *Malden* and the *Viscountess Bury*, is building an electric launch 40 feet long, 5 feet 8 inches beam, to the order of Mr. Andrew Pears, which, it is expected, will be ready before the end of the present month. This, we believe, will be fitted with Mr. Sergeant's patent motor shaft and thrust block combined, a self-lubricating arrangement that reduces friction to a minimum. In addition to the only charging station in existence last summer, which is now located at Hampton, opposite the waterworks, another has already been placed at Kew Bridge, and a third is about to be constructed above Richmond Bridge.

**Institution of Electrical Engineers.**—On Friday evening last, by kind permission of Mr. Spagnoletti, the students visited the Electric Light Works of the Great Western Railway at Paddington. They were conducted round the station by Mr. Walton, who explained the whole of the working to them. The visit being both pleasant and profitable.

**The Priestman Oil Engine.**—From a number of testimonials printed by the makers of this engine we learn that one has been working for some time with satisfaction at the E.P.S. Works at Millwall charging accumulators. At Wolverhampton one has been working since January, using the commonest oil and keeping a dynamo running without any attention for ten hours per diem. From Sheffield, Bradford, Lancaster, Prescot, and Manchester, where it is employed for the same purpose, users testify to its steadiness and regularity of running, as well as the little skill or trouble needed in its manipulation. Messrs. Lea, Son & Co. have been using one for some months in their central station at Shrewsbury, and are well pleased with its cleanliness and simplicity. As pointed out in one of the testimonials, "There is now no reason why every country house should not be lighted by means of electricity; and as a few hours' run supplies all the power needed for the night's requirements, the engine could be used for a variety of domestic purposes during the day."

**Telegraphing the Derby Result.**—We are informed that the result of the Derby, which reached the Direct United States Cable Company's Throgmorton Street office at 3 hr. 8 min. 30 sec. p.m. from Epsom, was transmitted to New York and delivered to addresses at 3 hr. 8 min. 32 sec. p.m. (Greenwich time). This beats all record. Ahem!

**Communication with South Africa.**—The Eastern Telegraph Company notifies the opening for traffic of the Eastern and South African Company's new West Coast cable to Cape Town, thus affording an alternative means of telegraphic communication with South Africa.

**Britannia Telegraph Works.**—In the notice of these works in our issue of 31st May, we omitted to state in connection with the growing importance of the gutta percha and cable department of the business, that this is in the sole charge of Mr. F. Whiteley, a director of the company.

**The Mammoth Combination.**—The prospectus has been issued of the Electric Construction Corporation, Limited. The authorised capital is £500,000 in £10 shares, in which are included 100 founders' shares, and applications were invited for 45,000 shares, the subscription list to close on or before yesterday at 4 p.m. The undertaking has been formed for the purpose of amalgamating and purchasing the patents and businesses to which we have on several occasions alluded, and to which we again refer in our other columns Taking into consideration the present financial position of certain of the undertakings included in the amalgamation, one can quite understand how needful it is for them that it should be carried through, as they would then be practically bought out in cash at par. Regarding the directorate, which at a first glance appears unusually strong, we have reason to believe that nine out of the eleven are either directors of the vendor companies or friends of the promoter. The holders of the founders' shares have each to underwrite £2,500 worth of ordinary shares, and as there are 100 of these shares it follows that £250,000 of the capital is underwritten. The whole capital of £500,000 is offered for subscription, so that if the public "come in" for say only £250,000, the founders become what is known in the City as "stuck" with their shares. The state of the market yesterday showed us that the founders are doing all they can to avoid this unpleasant catastrophe by selling their shares, as on enquiry of a broker we found the shares quoted ½ discount to par—all sellers. We understand that the sums which are to be paid for the properties taken over are, in round numbers, as under :—

| | Total amount. | Cash. | Shares. |
|---|---|---|---|
| Elwell-Parker ... ... | £49,000 ... | £26,000 ... | £23,000 |
| Electric Power Storage ... | 171,600 ... | 171,600 ... | ... |
| Ry. Electrical Contractors | 14,000 ... | 12,000 ... | 2,000 |
| Julien Patent ... ... | 40,000 ... | 20,000 ... | 20,000 |
| Sprague Patent ... ... | 14,000 ... | 12,000 ... | 2,000 |
| | £288,600 | £241,600 | £47,000 |

**A Flaw in the Telephone Amalgamation.**—The following letter has been addressed to the secretary of the United Telephone Company by Sir Arthur Blackwood, secretary of the Post Office :—"Sir,—The Postmaster-General has had his attention called to the notice issued by the United Telephone Company to its shareholders on the 24th ultimo, and to the course which the telephone companies propose to pursue with the view to an amalgamation. Whether such course can be legally adopted under the terms of the licenses granted by the Post Office is a question on which the Postmaster-General does not at present offer an opinion, but he desires me to acquaint you, for the information of the directors and shareholders of the United Telephone Company, that the amalgamation of the companies was not contemplated when the licenses were issued, and that any assurances, outside the licenses, which the companies may conceive themselves to have received from the then Postmaster-General cannot be regarded as applicable to the state of things likely to result from the proposed amalgamation."

**Electrically Controlled Steam Roarer.**—Messrs. Cox-Walker, of Darlington, have erected an electric apparatus at the North Riding Asylum, by means of which the steam roarer can be started by simply pressing a button or pulling a knob.

**A New Graphophone Syndicate.**—A special despatch from Philadelphia says :—" A syndicate of Philadelphia capitalists, headed by Thomas Cochrane, has purchased the graphophone rights for the world outside of the United States and Canada. The price paid was $500,000."

**Another Subway Explosion.**—An explosion in the New York subways occurred at the corner of Union Square and West Fifteenth Street, where the thoroughfare was rather badly broken up. Fortunately the explosion occurred at night, when there were very few people in the vicinity. The leakage of gas is again said to be the cause.

**" Coming Events, &c."**—In the annual report of the Gas Committee of the Manchester Corporation, to be presented at the ensuing meeting of the Council, we find the following remarks :—" The questions relating to the supply of the electric light are under the consideration of the committee, and the improvements which have taken place in the production and management of this illuminant, and the conditions upon which it can be supplied, may justify the committee in arranging for its adoption to some extent. They will report to the Council in reference to this matter on an early date."

**Personal.**—Mr. Herbert L. Webb, who has recently arrived in America, says the *Electrical World*, with excellent introductions, is a nephew of Mr. F. H. Webb, the well-known secretary of the English Institution of Electrical Engineers. He is a young electrician, who has had great experience in submarine and underground work, as well as in cable construction ; and he proposes to devote his attention and energies to subway work in this country.

**The Thomson-Houston System.**—The electric light installation at St. Pancras Station has been successfully carried out, and another is now ordered for the new Midland Station and sidings at Bradford, where the plant will be for 150 arc lamps. The Thomson-Houston system has also been recently fitted at the Willow Walk goods station, L. B. and S. C. Railway, where 100 arc lamps are driven by three large gas engines. This system is also installed at Taunton, Waterford, Sheffield, and Reading Stations, and is to be fitted at the central stations of Exeter and Bath.

**Platinising Porcelain.**—M. Sénet has invented a method of coating porcelain with platinum by applying bichloride of platinum slightly moistened with hydrochloric acid, and baking it in a muffle furnace at a temperature of 1,000° to 1,200° C. The heat reduces the chlorine, and the metal combines with the porcelain. The inventor has made some electrodes by this process, which were extremely satisfactory.

**The Theatrophone.**—The proposed distribution in Paris of dramatic and musical compositions by the " Theatrophone" will arouse the ire of dramatic authors and musical composers. We might suggest that—assuming the law to be the same for copyright in France as in England—the users of the murderous instrument be charged individually the full license fee as for a separate public performance.

**Copper.**—Copper deliveries for May reached 13,864 tons, against 8,509 tons in April ; 4,399 tons in March, and 1,397 tons in February. The price of £41 per ton quoted for Chili bars, and G.M.B., is bringing the consumer into the market ; the visible stocks have been reduced from 124,447 tons to 117,420 tons.

**How does He do it ?**—Mr. C. B. Harness admits that he, himself, has £50,000 sunk in his business, and he does not consider that " £1,000 per annum is nearly sufficient to cover such a large investment." Perhaps not, but we always understood his income from the concern was nearer £6,000 than £1,000.

**Board of Trade Licenses.**—The Board of Trade has refused the application made by the Brighton and Hove Electric Lighting Company.

**Tempus Fugit.**—The Leeds Corporation, who are taking time to complete their report on the advisability of keeping the electric lighting of the city in their own hands, have caused some anxiety among their citizens lest there should be no supply of electricity for next winter.

**Useful after all.**—The electric light on the top of the Eiffel Tower was the other night turned on a disabled barge on the River Siene and enabled the crew to save both the cargo and barge.

**Growth of the Telephone System at Sheffield.**—For the week ending May 24th, 55,538 messages were sent as against 23,904 in the corresponding week of last year.

**Awards for Technical Papers.**—The Council of the Institution of Civil Engineers has awarded a Telford medal and a Telford premium to Gisbert Kapp, Assoc. M.Inst.C.E., for his paper on "Alternate Current Machinery," and it has also given a Millar prize to Samuel Joyce, jun., Stud. Inst. C.E., for his paper on "Electrical Measuring Instruments : their Properties and Calibration."

**Telegraph Cable Fouling.**—The *Shipping Gazette*, with reference to a query as to whether a telegraph cable, if accidentally damaged by the anchor of a ship, should be repaired at the expense of those causing the damage, states that the shipowners are not liable unless the damage was done through the fault of those on the ship, and not accidentally ; the *Gazette* refers to the case of *Clara Killam*, 3 A and E, 161, and 48 and 49 Victoria, c. 49, in support of its contention.

**The late Mr. Newall.**—The personal estate of Alderman Newall, of Gateshead, the submarine cable manufacturer, who had a place in the Strand, is valued at £166,981. Mr. Newall, it may be recollected, manufactured the first successful Dover and Calais cable in 1851.

**The Royal Society.**—Yesterday the following papers were down for reading :—T. Andrews, F.R.S., " Electro-Chemical Effects on Magnetising Iron—Part III." A. Mallock, "The Pysical Properties of Vulcanised India-rubber." V. H. Veley, " The Conditions of the Reaction between Copper and Nitric Acid."

**Central Stations in Berlin.**—Herr Oscar von Miller has read a paper before the Berlin Elektrotechnisches Verein, in which he gave some particulars as to the progress made during the past year in central station lighting in Berlin. At the Mauerstrasse central station, which has three steam engines of 180 H.P. and three of 300 H.P., new dynamos were erected for lighting " Unter den Linden." The central station in Markgrafenstrasse was enlarged. There were formerly five boilers and six engines of 180 H.P. The additional power consists of four boilers, and besides these, four steam dynamos, each of from 300 to 400 H.P., have been erected. The network of cables for these two stations was extended from 15 km. of house frontage to 25 km. To this network there has been added the station in the Friederichstrasse, which belonged to the Allgemeine Elektricitäts Gesellschaft, where the power is over 300 H.P. There is, therefore, a total of 4,000 H.P. available there, sufficient for 50,000 16-C.P. lamps. Owing to the Berlin Elektricitätswerken having agreed with the Municipality to supply a certain large district, it was found necessary to erect two new stations, one in the Spandauerstrasse, and one in the Schiffbauerdamm. The buildings for the former are completed, and the plant is now being got ready. The latter installation will be similar to that in the Mauerstrasse.

**The New Electrical Sugar Refining Scheme.**—The following is the method which it is proposed to follow in M. Baudet's patent for refining sugar by electrical means, to which we briefly referred in our issue of May 10th :—The raw sugar is placed in a centrifugal action machine, hermetically closed by means of a lid which is traversed by the two current conducting wires, of which the extremities are in the interior of the machine, at a short distance one from the other. Steam is introduced into the machine ; then, when the sugar is sufficiently humidified, the electric circuit is closed and a series of sparks is produced, these bringing forth ozone, by which the refining is effected. The syrup which results from the action of the steam on the sugar, and which is separated by the centrifugal force, may be mixed with fresh raw sugar, and then subjected to the same treatment.

**Receipts for Telegrams.**—In the House of Commons recently, Mr. Henniker Heaton asked the Postmaster-General whether he was aware that if a receipt was required for a 6d. telegram a fee of 2d. was demanded by the Telegraph Department ; and whether he would take steps to reduce that charge to 1d. Mr. Raikes, in reply, said he thought that the fee mentioned by the hon. member was certainly excessive in the case of 6d. telegrams, and he should be glad if, after consulting the Treasury, he should find himself able to reduce it.

## NEW COMPANIES REGISTERED.

**Electric Construction Corporation, Limited.**—Capital £500,000 in £10 shares. Objects : To adopt a provisional agreement of 17th ult. between Herbert Edward Tarver and Andrew Wallace, and to carry on in all branches the business of an electrical construction company. Signatories (with 1 share each) : Sir C. Douglas Fox, Kingston-on-Thames ; Sir Daniel Cooper, Bart., 6, De Vere Gardens, W. ; James Pender, Thornby Hall, Rugby ; Sir Hy. C. Mance, Bedford ; J. B. Verity (electrical engineer), King Street, Covent Garden ; J. Irving Courtenay, 1, Essex Court, Temple ; Joseph Smith, Oakeswell Hall, Wednesbury. The directors (exclusive of the managing director) are not to be less than 3 nor more than 15 in number. Qualification : 100 ordinary shares or £1,000 stock ; the subscribers are to appoint the first. Remuneration : £3,000 per annum, with a further sum of £250 in respect of each director over 11, and a further additional sum of £1,000 for each 1 per cent. of profits available for dividend after payment of 10 per cent. on the ordinary shares. Messrs. Joseph Smith and Thomas Parker are respectively appointed managing director and works director. Registered 29th ult. by Linklater & Co., 2, Bond Street, Walbrook.

**Woking Electric Light Supply Company, Limited.**—Capital £20,000 in £5 shares. Objects : To construct and carry on works, machinery, and apparatus for public and private lighting by electricity, and to produce, store and use, light and heat, and electric, magnetic, or other force. Signatories (with 1 share each) : *E. H. Stevenson, C.E., 38, Parliament Street ; J. H. Douglas Mackenzie, 15, St. George Street, S.W. ; *H. Sampson King, Founder's Hall, St. Swithin's Lane ; E. E. B. Maunce, 46, Parliament Street ; Spencer Chadwick, 17, Parliament Street ; S. Bircham, 46, Parliament Street ; E. Price, 15, Holdernesse Road, Upper Tooting, S.W. The signatories denoted by an asterisk are the first directors, together with Messrs. H. C. Masterman, S. Charles Phillips, and A. A. Gale ; qualification : £100 in shares or stock ; remuneration : £50 per annum, multiplied by the number of directors for the time being, and a similar amount from the surplus remaining after payment of £8 per cent. per annum dividend. Registered 30th ult. by Bircham & Co., 46, Parliament Street.

**Leeds Safe Deposit Company, Limited.**—Capital £20,000 in £5 shares. Objects : To erect buildings for the safe custody of valuables, and in conjunction therewith to carry on the business of electrical, gas, and mechanical engineers, and all other business relating to lighting and heating. Signatories (with 1 share each) : J. M. Hooner, 244, Stockwell Road, S.W. ; A. F. Shuttleworth, 27, Gilmore Road, Lewisham ; A. E. Bithery, 9, Holland Road, N. ; R. Richards, 54, Wenlock Road, N. ; W. H. Jones, 6, Holland Road, N. ; Hy. Parsons, 1, Stanbury Road, Peckham ; A. Smith, 9, Buckland Street, N. Registered 31st ult., without articles of association by H. F. Oddy, 58, Lombard Street.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**Telegraph Manufacturing Company, Limited.**—The annual return of this company, made up to the 30th ult., was filed on the following day. The nominal capital is £50,000 in £10 shares. The number of shares taken up is 2,276, and upon these the full amount has been called. The calls received amount to £16,300, and the full amount is considered as paid upon 646 shares.

**Medico-Electric Belt, Truss and Battery Company, Limited.**—At an extraordinary general meeting of the shareholders in this company, held at 58, New Bond Street on the 6th ult., it was resolved to wind up voluntarily, Mr. J. W. Biggs, of 12, Delahay Street, Westminster, being appointed liquidator. The resolutions were confirmed on the 22nd ult., and were duly filed on the 27th ult.

**West India and Panama Telegraph Company, Limited.**—The annual return of this company, made up to the 22nd ult., was filed on the 29th ult. The nominal capital is £2,445,630, divided into 200,000 ordinary, 35,563 first preference, and 10,000 second preference shares of £10 each. The shares taken up are 88,321 ordinary, 34,563 first preference, and 4,669 second preference, upon all of which the full amount has been paid, the paid up capital thus being £1,275,530.

**Elmore's Patent Copper Depositing Company, Limited.**—An agreement of March 8th entered into with Wm. Elmore, Francis Edward Elmore, and Alexander Stanley Elmore, of 22, Great Castle Street, called the vendors, provides for the purchase of certain patent rights, under which the vendors claim to produce copper tubes, without limit as regards size, at the price of under one penny per pound, on the basis of an output of 20 tons per week above the price of the Chili Bar or other rough copper, and that the anodes from which the same is deposited may be of ordinary cast copper, and that they have no trouble from the connections, that such copper articles have absolute uniformity of density, thickness, tensile strength, and true circular section, that there is practically no limit to the diameter of the pipes and other articles which can be made, that the copper can be varied in tensile strength and ductility exactly as is required, and that the electrical conductivity of the copper is for all practical purposes about 102½ per cent. of Matthiessen's standard of pure copper, and that the copper articles can be produced of a tensile strength of over 22 tons to the square inch, with an elongation of over 7 per cent. The purchase consideration is £53,400 cash, and 23,300 fully paid shares of £2 each. Registered office, 20, Bucklersbury.

## LEGAL.

**In re New Telephone Company.**—Before Mr. Justice Stirling, in the Chancery Division, on Saturday, a petition for winding-up under supervision order was presented by the company itself.—Mr. Buckley, Q.C., stated that the company in November, 1884, commenced to carry on a telephone business. The capital of the company was represented by 1,000 shares issued as fully paid up, and £9,433 paid on other shares. The collapse of the company had been caused by an action having been commenced in March last against them by the United Telephone Company, to restrain this company from working infringements and other patents. An injunction was obtained in that action which had not been further prosecuted. Nothing further had been done by the company, which, unfortunately, had got to the end of its powers. An extraordinary general meeting was held on April 29th last, when the company passed an extraordinary resolution in favour of winding-up, and for the appointment of Mr. Ogle as liquidator. The debts amounted to £2,339, and assents to the supervision order being made, had been signed by the majority of the creditors. His lordship made the order asked.

**Mariners' Compasses.**—Last week, in Dublin, the Irish Court of Appeal gave judgment in the appeal by Sir William Thomson, of Glasgow, from an order of the Master of the Rolls, refusing an attachment against Mr. Moore, of Belfast, for infringing his patent rights with respect to certain compass cards invented by him. The Lord Chief-Baron, in an elaborate judgment, said the card of the defendant nearly corresponded with that of the plaintiff. In the elements of lightness, a long period of free vibration, and other details, the points of difference were immaterial. The order of the Master of the Rolls ought therefore to be reversed. The other members of the Court concurring, the order of the Court below was reversed. Afterwards counsel for the defendant intimated that he should appeal to the House of Lords, and the Court thereupon stayed the judgment pending such appeal.

## CITY NOTES, REPORTS, MEETINGS, &c.

### United Telephone Company.

MR. JAMES BRAND presided on Tuesday afternoon at the City Terminus Hotel, Cannon Street, over the ninth annual ordinary general meeting of the United Telephone Company, there being a fair attendance.

The Secretary, Mr. Thomas Blaikie, read the notice convening the meeting.

The report for the year ending 30th April, which was taken as read, appeared in our last issue.

The Chairman said: Gentlemen, during the last few months your accounts have been subjected to very severe inspection by our two subsidiary companies—with whom, I hope, you are now going to amalgamate—as well as by our own auditors. They have all agreed that we can pay you a dividend of 17½ per cent., while we increase your reserve fund by about £10,000, arising from premium on new shares issued. Your share capital is now £500,000, against £483,000 last year. This is an increase of £16,500, partly owing to the amount called up on the new issue of shares after the end of our last financial year, and a further issue since of the remaining 978 shares. On the whole of this amount the 17½ per cent. dividend has to be paid, making an increased payment to the shareholders of over £9,000. As to revenue, we carry forward £4,000 more of unearned subscriptions for the benefit of next year. I won't say any more as to the accounts just now, but by and by will be happy to answer any question that may occur. I will say a word or two as to what we have been doing, and then get on to the resolutions for amalgamation. To meet the wishes of many subscribers, we have established an all-night service throughout the West End of London—Chancery Lane, King's Cross, &c. At present this means chiefly an increase of expense, but we hope it will more and more prove the usefulness of the telephone, and add to the number of our subscribers. So far the calls have been very few, but they are gradually rising, and last week they averaged 123 per night between the hours of 9 o'clock p.m. and 9 in the morning, and on Sundays 216. We have now 28 call rooms in and about London open. We have nine more to be opened shortly, and we have concluded an arrangement with the Aerated Bread Company which will very soon cause the opening of something like 80 fresh call-rooms in the most frequented places in London. A local exchange has been opened at Bromley, in Kent, which is now being joined to our London system by trunk. We have already an independent trunk line between London and Croydon, and a local exchange with 42 subscribers. The number is few, but we have worked very hard to get them. Te encourage the enterprise we have put the Croydon Hospital on the system, and joined up the medical men free of charge. The Brighton business in itself is, I believe, doing very well for the South of England Company, but we have not had the success we hoped for, as far as the inter-communication with London is concerned. We believe this to be owing to the uncertainty of our wire. This was put up on the ordinary railway telegraph poles by the General Post Office. It has cost us a good deal of money, which, except as a useful experiment, has been more or less thrown away. The South of England Company has now entered into a special arrangement with us for the purpose of a call-room between London and Brighton. The route has been surveyed and the work begun, so that we may join our Croydon trunk wires on the Brighton direct, or special poles, which will be free from induction, and we hope to induce a large telephonic business between London and Brighton and the intermediate towns. I am glad to tell you that we have a quiet space within the Stock Exchange of London, and are erecting a special trunk line between the Stock Exchanges of London, Liverpool, and Manchester, entirely for the use of the members of these exchanges. Our trunk is now complete for nearly 94 miles betweeen Birmingham and London, and, barring difficulty of getting wayleaves about Hampstead, the London end will be completed in a week or two. The road to the north of Birmingham is being surveyed. Through the National Company's wires, now in existence beyond Birmingham, we hope to put the Stock Exchanges in communication very shortly, and to put them in perfect communication by the special trunk in a few months. If this line is a success, as I fully believe it will be, it will have a very valuable effect on your property, or rather, as I hope, on the property of the amalgamated companies. At the date of the general meeting last year we had obtained an interim injunction against the Equitable Telephone Association, restraining the use of the Campbell-Swinton telephone, and the defendants in that case threatened to fight the whole question of the validity of the patents, as also the question of infringement. But I am glad to say that they thought better of this, and in December last they submitted to a perpetual injunction in the usual terms, surrendering all instruments in their possession, and giving particulars of all instruments supplied. The company speedily went into liquidation. We have since had to take action against the New Telephone Company to restrain the manufacture and sale of Silvanus Thompson's valve telephone. In this case, again we were threatened with a heavy fight; but after we had given notice of motion for an interim injunction, they surrendered at discretion, and the result has been the same as in the case of the Equitable Telephone Company. The Court made a winding-up order against them on Saturday last, and I am afraid that the people who have been buying instruments from them on the faith of their indemnity will find that indemnity of very small value. We have, as you are aware, throughout adopted the policy of waiving proceedings against purchasers and users of these instruments on their giving up the offending instruments. Some 2,000 instruments have been surrendered during the last 12 months, and the various district companies have in very many cases supplied licensed instruments in their place. It is not a very wise thing to prophesy, but I really think that in the face of the complete collapse of these infringing companies, leaving their guarantees unpaid and their shareholders with a total loss of their capital, we are not likely to see any similar companies started during the remainder of the terms of the patents. You will wish now to come to the question of amalgamation, which is the most interesting question to-day, and I shall have this afternoon to propose some resolutions, which I hope you will pass, to enable us to carry this amalgamation into effect. We first considered this matter about two years ago, and, as time went on, it became more and more evident to us that amalgamation is the right course for us to pursue if we want to turn our investments in telephonic enterprise into a really high-class security or property. When first we entered into this enterprise we found that our one combination was not sufficient to carry on and develope an entirely new business all over the country at once, but that to enable us to cover the ground without delay it was necessary to divide and scatter our forces all over the country as much as possible, and to enlist the interest and sympathy of all classes of people, and in every centre of population and industry. This was done by the establishment of the Lancashire and Cheshire Company, the National Company, the Western Counties Company, the South of England, the Northern, and the Telephone Company of Ireland. These companies have excellently proved the wisdom that dictated their formation, and the various towns all over the country are more or less feeling the benefits of telephony. But the division of the country and the districts in which the United Company and its subsidiary companies are allowed to carry on their business has given rise, in many instances, to differences of opinion and complications which have rendered it necessary to come to special agreements when we have wished to put towns and districts and systems in direct communication with one another. By the union all these difficulties and differences will be overcome, the work will be carried out under one management, and when wayleaves have been obtained in the various localities the building of the trunks will be more rapidly carried out. Economy in management will result, decisions as to policy will be more rapidly arrived at, and more power at our elbows will ensue. Following out the same train of thought, while it was necessary in the first place to distribute our energies by the division of our forces, it becomes—now that our purpose has been to a great extent achieved—desirable, in the face of the quick approach of the expiry of our patents, to once more bring our components together, so that we may make up by the concentration of our forces and our business any loss of power which would ensue from the expiration of our patents. Besides, our friend, the Postmaster-General—who, in the pursuit of the duties of his office, acts as a very keen trader, always on the look out seeking whom he may devour—would certainly be more able to bring his devices to pass if he had to deal with the various companies singly, and one after another, than if he had to deal with one great company, strong in unity and financial position, and with one strong executive body. I really don't know what more I can say, or that it is necessary for me to say, to put before you the great advantages of this union in the first place of the United Company with its two elder children. The union will have the same effect as the tying together of the bundle of sticks in the fable. While we are apart any one can try to break us and interfere with us in many ways, but when we are tied up together we become an altogether different article, and much more capable of defence and of resisting offensive treatment by any person whatever. While we are separate we are, to a certain extent, financially as well as otherwise weak, but when we amalgamate we have much greater ease with finance, and can raise money on much cheaper terms, and our shares, which up to this time have been of a somewhat speculative character, owing to the various difficulties which beset us, become property, according to my mind, of a much more valuable kind and quality. We have told you in our notice the reason for uniting the three companies under the name of the National Company, instead of, as would have been more natural, the two other companies coming together under the wing of our company, the United Telephone Company. It is naturally somewhat hard for us to change our name, but we have to look at the welfare of the whole body, and not be guided by our individual feelings. We must, therefore, eat the leek provided for us by the Postmaster-General in declining te grant the United Telephone Company permission to assign its licence, which would have obviated this necessity, without in any way interfering with the rights and interests of his Department or the Government. I understand that the Postmaster-General declined to grant us what we desired on the ground that the monopoly created by such a licence, and by such acquiescence in our desires on his part as might be implied by such a grant, would be contrary to public policy and injurious to the interests of the public by the clearing away of competition. Now, when he said this the Postmaster-General was drawing a red herring across the scent of the public. He knew full well that ever since the granting of the separate licences to each company there had been no competition, as each company had worked its own territory without interfering with its neighbour, and all have been working to one end and for the joint benefit of the public, themselves, and the United Telephone Company. Why the Postmaster-General refused to grant the permission we asked for is not very clear; but if he had been perfectly frank with us he might have put it somewhat as follows:—"You, gentlemen, bought with a large expenditure of your money an entirely novel and most amusing invention. We, the department, had just as good a chance of buying this extraordinary thing for ourselves, and so adding immensely to the power of the department for the public good. However, as we were so short-sighted that we failed to recognise the beauty and value of the thing, we allowed you and your friends to step in and take the invention for yourselves, believing that it was a plaything, and you would soon lose your money and get tired of it." As soon as we had proved that it was no plaything, but was going to be a commercial success to the country, and a source of profit, he stepped in and said: "Your great invention is only a telegraph, after all. It belongs to us, the General Post Office, and if we allow you to use it you must pay us £13 out of every £100 gross you receive." And a gross thing it was. ("Oh!" and laughter.) Well, we payed him this enormous tax, amounting now to near, say, £35,000 per annum, which costs him nothing to collect, and now, finding that in spite of this burden placed upon us we are getting stronger and more useful every day, he pursues the old tactics of placing every obstacle in the way of our progress, and reminds me of the wicked husbandman in the parable, who said, "Here is the heir; come, let us kill him, and his inheritance shall be ours." Gentlemen, the fate of that husbandman was not a happy one. (Laughter.) What he really fears is what we hope, which is, that the union of the telephone companies will lead to better management, greater economy, and to better service to the public, and the possibility in the end of a cheaper exchange system. I think I need say no more to induce you to pass the resolution I have to propose. Remember that union is strength, and in the matter of telephony it means also economy, efficiency, and cheapness. I beg to move the following resolution: "That the report and accounts taken as read be received and adopted, and that a dividend for the half-year ending April 30th, 1889, of 12s. 6d. per fully paid-up share, less income tax, be paid, making a total dividend for the year of 17½ per cent. on the paid-up capital of the company."

Mr. J. S. Forbes seconded the adoption of the report, which was unanimously agreed to.

The Chairman then moved the first resolution with regard to the amalgamation: "That the agreement submitted to this meeting, and expressed to be made between this company and the National Telephone Company, Limited, for the amalgamation of the two companies, by a transfer of the business and property (with certain exceptions) to the National Telephone Company, Limited, in consideration of shares in that company be, and the same is, hereby approved."

Mr. J. S. Forbes seconded.

In reply to questions by shareholders, the Chairman stated that the articles of the National Company would be considerably altered so as to suit the new company; and the lawyer said that the exceptions mentioned in the resolution were those of the licences, the shares in the National Company, and the dividend just declared.

A shareholder referred to the fact that a question was down to be asked in Parliament with regard to the amalgamation, and questioned whether they were not acting contrary to public policy, and endeavouring by a side wind to do what the Postmaster-General opposed.

The Chairman said the board had not noticed the question till too late, and somewhat indignantly declared that they were acting fairly and above board.

Mr. F. Leyland pointed out that the Postmaster-General could not prevent them from selling their business, and that they were doing what the had a perfect right to do, and said that they had consulted with the best members of the Bar.

A Shareholder having supported the resolution, the Chairman, replying to questions, said that he could not make any statement as to the appointment of a managing director for the new company, but that the opinions of the United Company should have due weight. He also stated that the directors would not receive extra remuneration for their services in the new company, but their fees would be limited to £5,000.

A Shareholder urged that between that meeting and the extraordinary one to confirm the resolutions, the particulars of the amalgamation should be put in the hands of the shareholders, as many had not yet had, or had not embraced, the opportunity of perusing them.

The Chairman stated that the new board would consist of all the members of the United Telephone, four of the directors of the National Telephone, and four of the Lancashire and Cheshire: Messrs. Agnew, Batten, Brand, Rouse, Forbes, Peter Garnett, Heyworth, Leyland, Morgan, Dillwyn Parrish, Quilter, E. H. Robertson, Sands, Colonel Jackson, and Alderman Joseph Thompson.

A Shareholder thought the meeting might very well leave the question as to who should be appointed as the executive to such a board, which would be a very superior one.

In reply to a shareholder, the Chairman stated that all the shares held by the company in subsidiary companies would be embraced in the amalgamation.

The resolution was then unanimously adopted.

The following two resolutions were also passed, on the motion of the Chairman, seconded by Mr. Forbes, the only question put being with regard to the word "specie" in the last one, which was explained to signify that the shares would be distributed as shares:—"That with the view of giving effect to the above-mentioned agreement, and in order to enable the shares to be allotted thereunder to be distributed among the members of this company, this company be wound up voluntarily, under the Companies Acts, and that Mr. Thomas Abercrombie Wilton be, and he is hereby, appointed liquidator for the purpose of winding up its affairs and distributing its property." "That, pursuant to the 161st section of the Companies Act, 1862, the liquidator be, and he is hereby, authorised to carry the said agreement into effect, and to receive the shares agreed to be allotted thereunder and to distribute the same, together with the shares of the National Telephone Company, Limited, already held by this company, in specie, among the members of this company."

Sir E. H. Galsworthy moved a vote of thanks to the chairman and directors, expressing appreciation of the way in which the amalgamation had been arranged.

A Shareholder seconded.

The Chairman having responded, the proceedings concluded.

The following circular was distributed in the room, explaining the amalgamation scheme:—

"The directors of this company have been engaged for some time past in arranging a scheme for the amalgamation of the company with the National Telephone Company, Limited, and the Lancashire and Cheshire Telephonic Exchange Company, Limited, the intention being to form a new company which should acquire the property of the three companies, the new company issuing its shares to the latter on the basis of £15 to this company, £6 to the National Company, and £1 11s. 6d. to the Lancashire and Cheshire Company, those figures representing the then market price of the shares. As, however, the Postmaster-General objects to the licences held by the three companies being transferred to the proposed new company, the formation of that company must be abandoned.

"The amalgamation of the three companies is now intended to be effected by the purchase of two of them by the third, the latter company giving its shares as the purchase price. As the licences held by the companies extend to the whole of the United Kingdom, any one is sufficient to cover the business of all three companies when amalgamated.

"The purchasing company must obviously be the one whose shares are nearest to par in market price. The National Company most nearly complies with this condition, and it is therefore proposed that that company should absorb the Lancashire and Cheshire Company and this company.

"As, owing to legal considerations, the National Company's shares can only be taken at their par value, it is necessary to nominally reduce the figures originally proposed as the basis of the amalgamation, which will then stand as follows, viz.:—£12 10s. for each share of this company, and £1 6s. 3d. for each share of the Lancashire and Cheshire Company, the National Company's ordinary shares, representing the purchase price, being taken at par (£5).

"You will observe that the above amounts are simply the figures of the former arrangement reduced by one-sixth all round. The relative values of the interests of the shareholders of the three companies are therefore unaffected by the variation, the result being that the shares whilst of a rather less nominal amount will produce a corresponding higher rate of dividend, and may, therefore, be expected to command an equivalent price in the market.

"The new arrangement will take effect as from May 1st inst., and power has been reserved to pay a dividend to the shareholders of this company for the period ending April 30th last."

## The National Telephone Company, Limited.

The ninth annual ordinary general meeting of this company was held at the Cannon Street Hotel on Tuesday, Colonel R. Raynsford Jackson presiding.

The secretary (Mr. Wm. B. Campbell), having read the notice convening the meeting, which referred to a proposed scheme for the amalgamation of the company with the United Telephone Company, Limited, and the Lancashire and Cheshire Telephonic Exchange Company, Limited, the following report was taken as read:—

"The accounts now presented to you are made out for a period of 10 months to 30th April, instead of as usual for an entire year. This change is consequent upon the proposed purchase by this company of the United Telephone Company, Limited, and the Lancashire and Cheshire Telephonic Exchange Company, Limited, in accordance with agreements which will be submitted to the meeting for approval.

"Capital Expenditure.—The capital expenditure for the 10 months has been £52,747 0s. 5d.

"Revenue.—The gross revenue allocated to the past 10 months is £97,426 5s. 8d., and the amount carried forward to next year is £63,053 0s. 8d. The annual rentals on April 30th reached £121,978 3s. 1d. There is also a revenue derived from fee messages, at the rate of £4,000 a year, making the total gross revenue reached on April 30th £125,978 3s. 1d., against £109,572 12s. 7d., for the year ending June 30th, 1888, and giving an increase of £16,405 10s. 6d., for the 10 months subsequent to June 30th, 1888.

"Dividends.—After providing for the accrued interest on the debentures, for a dividend for 10 months at the rate of 6 per cent. per annum on the amount paid up on the first and second preference shares, and after having paid an interim dividend for the first half of the year at the rate of 4 per cent. per annum on the ordinary shares, there remains a balance of profit amounting to £15,952 17s. 9d. Out of this the directors propose to allot £10,687 10s. to the payment of a dividend upon the ordinary shares which with the interim dividend of 4 per cent. per annum will make up the dividend on the ordinary shares to the rate of 5¼ per cent. per annum for the 10 months. Of the balance then remaining, the directors propose to place £2,500 to the reserve fund, and to carry forward £2,765 7s. 9d.

"Trunk Wires.—The company has now 3,747 miles of trunk wire, being an increase of 1,238 miles since June 30th, 1888. The total length of the company's wires is 13,583 miles.

"New Exchanges.—The number of telephonic exchanges was on April 30th 135 with 9,371 lines. The lines of the private wire renters number 1,442 making the total number of exchange and private lines 10,813. The increase of exchanges is 18, and of exchange and private lines, 1,489.

"Retiring Directors.—The retiring directors are Messrs. Robert Raynsford Jackson, William Hardwicke Bradbury, and William Lowson, all of whom offer themselves for re-election.

"Retiring Auditors.—The auditors, Messrs. Welton, Jones and Co., also retire, and are eligible for re-election."

*Balance Sheet, as at 30th April,* 1889.

| Dr. | £ | s. | d. | £ | s. | d. |
|---|---|---|---|---|---|---|
| Revenue account, 1889–90: | | | | | | |
| Proportion of subscriptions and rentals in respect of periods extending beyond April 30th, 1889 | 63,053 | 0 | 8 | | | |
| Less amounts paid in advance for Post Office royalty and instrument royalty ... ... ... | 13,345 | 13 | 0 | | | |
| | | | | 49,707 | 7 | 8 |
| Preference dividend account: | | | | | | |
| Dividends for the 10 months ... | 12,615 | 0 | 0 | | | |
| Less paid to December 31st, 1888 | 7,295 | 15 | 1 | | | |
| | | | | 5,319 | 4 | 11 |
| Sundry creditors ... ... ... ... ... | | | | 30,839 | 17 | 11 |
| Reserve fund ... ... ... ... ... ... | | | | 11,000 | 0 | 0 |
| Net revenue account, balance at credit ... ... | | | | 15,952 | 17 | 9 |
| | | | | £112,819 | 8 | 3 |

| Cr. | | | | £ | s. | d. |
|---|---|---|---|---|---|---|
| Capital account: | | | | | | |
| Balance per statement ... ... ... ... | | | | 58,265 | 17 | 4 |
| Stock of material: | | | | | | |
| On hand at head offices and branches ... ... | | | | 24,948 | 2 | 1 |
| Office furniture: | | | | | | |
| On hand at head office and branches ... ... | | | | 3,305 | 6 | 10 |
| Outstanding rentals ... ... | £12,109 | 11 | 8 | | | |
| Sundry debtor balances ... ... | 8,575 | 9 | 1 | | | |
| | | | | 20,685 | 0 | 9 |
| Cash: | | | | | | |
| At head office and branches, in bank, and on hand... ... ... ... ... ... ... | | | | 5,615 | 1 | 3 |
| | | | | £112,819 | 8 | 3 |

On the amalgamation question, the secretary announced that the directors had received 269 proxies representing 79,494 shares, and that Col. Williams had sent five proxies representing 275 shares.

The Chairman then said: I am glad to see a much larger number of shareholders than usually attends this meeting. I can well understand the reason of their doing so. We have not only to deal with the ordinary business of the company, that is to ask your acceptance of the report and the declaration of the dividends, but we have also to consider an important scheme of what is practically amalgamation, and which has taken the form of purchase by the National Telephone Company of the United Telephone Company and the Lancashire and Cheshire Telephonic Exchange Company. I will, however, in the first instance, briefly refer to the report as it concerns the working of the National Telephone Company proper for the last ten months. I am happy to say that period has been for the company a prosperous one. We have increased our number of subscribers by 1,489, the total now being 10,813. We have increased the mileage of our trunk wires by 1,238 miles, the total being 3,747 miles, while the total length of the company's wires is 13,583 miles, and the gross revenue of the company is now, or rather was on April 31st, £125,978 3s. 1d., the increase for the ten months being £16,405 10s. 6d., or at the rate of close upon £20,000 per annum. This is the most considerable increase in revenue that the company has ever managed to secure. We have increased the exchanges of the company by 18, making the total number 135, and the call offices by 61, making the entire number 277. The net revenue earned for the ten months is £42,338 1s. 1d., or at the rate of close upon £51,000 per annum. After paying the preference dividends and interest on debentures and the sum of £3,502 17s. 9d., due upon old accounts to the United Company with reference to royalties, there is £24,952 17s. 9d. left which we propose to use as follows: £9,000 was paid as an interim dividend to the ordinary shareholders, and we now propose to make up the dividend of the ten months to 5¼ per cent., and that will absorb £10,687 10s. We also propose to add £2,500 to the reserve fund and to carry forward £2,765 7s. 9d. I may explain that the construction outlay for the ten months was £52,747 0s. 5d., and that over £16,000 of that was devoted to the construction of trunk wires. As I told you before we have increased our trunk wires by 1,238 miles, you will understand at what cost that additional mileage of wires to our system, which is most important to the interest of the public and the company has been created. I do not intend to dwell further upon the accounts of the company. You will say if we have been so prosperous, and I assure you the prospects of the National Telephone Company proper are still extremely good, why do we favour amalgamation? We have, as we think, quite sufficient reason to favour amalgamation, and the directors of the company who remain on the board are quite satisfied with the terms which have been arranged with the other two companies which are to join in this great and important undertaking. We favour amalgamation for a variety of reasons. In the first place, we think that the necessary consequence will be a great reduction in the aggregate expenditure of the combined companies. You can quite understand that that great reduction of expenditure will be very beneficial to the interests of the shareholders. We think also that we shall profit by the experience which has been acquired by all the companies joining in the amalgamation, and that we shall be enabled therefore to give to the public a better service all round than at the present, and that we shall also be enabled to meet the wants of a variety of interests that are, to a certain extent, neglected at the present. We bear in mind also that the National Company was in relation, and is at this moment in relation to the United Company in a peculiar position which may or may not be beneficial to its interests, and which could not be, I think, maintained without detriment to its interest. The United Company has half the voting power in most of the sub-companies, the National Company among them. The sub-companies cannot issue additional capital without the sanction of the United Company, and they are limited in the form of issue they adopt by the will and pleasure of that company. Now, I do not think that any shareholder will be indifferent to the fact that by amalgamation we get rid of the powers of the United Company with reference to our enterprise, and that we form part of a combined company which is under no such control. Our hope is that the result of the amalgamation will be to make London the heart and centre of a huge telephonic system, embracing its own suburbs, and such of the industrial towns of the United Kingdom as wish to have telephonic communication with it. We hope, also, as regards the provinces, that the extensive trunk communication which unites many of the towns in the provinces will be greatly improved and extended, and as between the towns in territories controlled by different companies we have no doubt whatever that the effect will be to save a great waste of time in negotiations and to supply trunk service in a direction most convenient to the interest of the public and best for that of the shareholders. We have no doubt that our enterprise will popularise the telephone, and will bring, on the part of the public, a greater feeling of credit towards the telephonic enterprise and those who wield it, and that the result will be largely beneficial alike to the shareholders and the public. Most of you, I suppose, have received a circular signed by Col. Williams. I will offer but a few observations upon that circular. This is the one dissentient note in our proceedings. The secretary has read to you the number of proxies which the directors have received, and I am happy to be able to inform this meeting that Col. Williams's circular has not caused the withdrawal of one single proxy, and the number of proxies which he has been able to send in support of his action are received from five shareholders and represent 275 shares. In one paragraph of Col. Williams's circular he says that the voting to-day will be a farce; that the United Company, in fact, will control the meeting; that the United Company's vote is the sole power—for this is practically the meaning of the paragraph—on which the directors rely for carrying out its designs and intentions with reference to amalgamation. Well, the fact is, that laying aside altogether the vote of the United Company, the directors have received proxies for 34,494 votes, a three-fourths majority of the shares outside those held by the United Company. The directors have also received proxies, which are too late, to the number of 945, but at all events we may judge of the views of the shareholders who send these proxies if we cannot count their votes. Then Colonel Williams seems to be in a state of great alarm as to what the Post Office may do, and in what direction it may show resentment at the amalgamation of the three companies. I feel no such apprehension. The Postmaster-General, no doubt, will be influenced by motives of policy in the course which he pursues, but he will not be stimulated by feelings of resentment or indignation because the companies have taken that course which they think best for their their own interest. I know well what the action of the department has, for years past, been with reference to the telephone companies, at all events with reference to the National Telephone Company. Its action has been fair and liberal within the lines laid down and imposed upon us by the license under which we work. I know that at the head of that department is a fair-minded and honourable man, because I have had important experience of his being so, and the head of the telegraph department, who has the principal share in dealing with the telephone companies, is also a fair-minded and liberal-minded man, and I apprehend nothing whatever from any legitimate hostility of that particular department. I can well understand that if the Postmaster-General thinks, either this year or hereafter, of buying the telephone companies, or some day or other of extending his own system in opposition to the telephone companies, it would suit his purpose better that they should remain distinct, and unable to act with vigour, rapidity and intelligence, and that he should be able to deal with them hereafter piecemeal. But although he may have that feeling you cannot suppose that a man holding his position in a powerful ministry would stoop to any unfairness in his dealings with the telephone companies. So I think we may dismiss altogether this scare with which Col. Williams has sought to impress us. Well, then, there is an extraordinary paragraph in this circular in which he talks of the large bonus which is to be received by the United Telephone Company and the bonus to be received by the Lancashire and Cheshire Company, and the absence of bonus of the National Company. He has called the bonus "bogus capital," but I have yet to learn that the legitimate earnings which are derived from the workings of any enterprise, and the additional increase consequent on the value of their assets, is to be regarded as "bogus capital." The value of the shares of the three companies has been fixed by the public, and the basis of our amalgamation is the public view of the value of these shares. The National Company could not, under any circumstances, as the purchasing company, give itself a bonus, but the companies taken over are taken over at the relative value that they held in the market at the time the amalgamation was fixed upon. I do not think it necessary to go further into detail upon that subject, and I think it very possible that Col. Williams may make the attempt hereafter to enlighten you, and I hope every attention will be given to what he has to say on this important subject. But there is one other paragraph in his circular with reference to which I would like to say a word or two. He speaks of Messrs. Carter and Carter and he calls them independent and disinterested experts. I have no doubt he is perfectly right in that expression. He speaks of myself and those he supposes to be engaged with me in connection with the negotiations of this proposed amalgamation as neither independent nor disinterested. I am sorry Col. Williams has seen reason to change the strong opinion he held with reference to myself which he expressed in a letter to me on April 6th. I will read you an extract, pithy, wonderfully well-expressed, and which I am convinced contains the honest sentiment that influenced him then. He said then: "I have your letter *re* amalgamation, and will be with you at your informal conference of the committee before the meeting on Saturday the 11th. It would, of course, be absurd on my part to offer anything worth calling an opinion upon details which need so much earnest study to master and then to weigh, as those which have been occupying your time and attention almost exclusively for months past. As I know and feel that your judgment in such matters is exceptionally strong and sound, and that you have nothing more at heart than the interest of the company, the success of which is mainly due to your perseverance and skill, whatever you recommend I shall heartily support." He goes on to say: "Of course, I see that the scheme involves my own eclipse, and I frankly own I shall regret to have to disappear, but I have never allowed personal considerations to weigh with me for a moment in a question of this kind, and I accept beforehand your recommendation whatever it may be." Col. Williams will probably, when he addresses you, explain his reason for the great change in his opinion since then. I must confess that I regret that he has seen reason to change his opinion. I doubt whether he will be able to convince you that he can justify that change. Before I sit down I will tell you briefly what the capital of the reconstructed company will be. You are aware that the first intention was that the shares of the United Company should be taken at £15, the ordinary shares of the National at £6, and the shares of the Lancashire and Cheshire at £1 11s. 6d. When the Postmaster-General refused to grant a licence to the new company to which the property of these three companies was to be transferred we had to consider whether we would still carry out the combination we thought so essential to the telephone interest, and it was decided at last that the National Telephone Company should purchase the other two. But the National Company could not increase its own shares from five to six, and it was therefore arranged that one-sixth should be taken off the price originally intended to be given by the other companies. The result of that arrangement was this: that the United Company will receive £1,250,000, the National £720,000, and the Lancashire and Cheshire £525,000. When I say the National will receive, I should say the National has received, and that the other two companies will receive the amounts I have mentioned. But the United holds shares in the National and Lancashire Companies, and the amount allotted to it includes the value of those shares. They are also included in the statement I have given you in the amount of shares designated as belonging to the Lancashire Company, and they will have to be deducted from the total sum which I have put before you. The United Company holds in the National Company 45,000 £5 shares, of the value of £225,000, and in the Lancashire Company 50,000 shares at the value of £65,625, which, put together, amounts to the value of £290,625. So that the amounts which will be the capital of the three companies in the first instance will be £2,204,375. I do not know that there is any occasion for me to occupy your time longer, and I will now content myself with moving the adoption of the report.

Mr. John Bruce (Edinburgh) seconded, and the motion was unanimously agreed to.

Dividends, as declared in the report, were then ordered to be paid, after which the retiring directors. Messrs. Robert Raynsford Jackson, William Hardwicke Bradbury, and William Lowson were re-elected. The retiring auditors, Messrs. Welton, Jones & Co., were also re-elected.

The Chairman next moved: "That the following agreement be and is hereby adopted and confirmed: an agreement, made between the United Telephone Company, Limited, of the one part, and this company of the other part, for the transfer of the United Company's business and certain property to this company, for shares in this company, and also an agreement made between the Lancashire and Cheshire Telephonic Exchange Company, Limited, of the one part, and this company of the other part for the transfer to this company of the business and certain property of the Lancashire and Cheshire Company, for shares in this company."

Mr. Peter Garnett (Thirsk, Yorkshire) seconded.

Col. Williams said the National Telephone Company was a very simple term but it covered more than one meaning. It meant on the one hand a group of individuals who had invested their money in that company and who were not engaged in any financial or other operation with any other company. The National Telephone Company also meant a group of financiers who had the command of the telephone companies of this country, and the interest of these two bodies was distinct and antagonistic. The antagonism remained dormant so long as the question of amalgamation was not brought to the front, but it became acute the moment it was brought to the front. So diametrically opposed was now the interest of the two bodies that it was perfectly impossible for the directors of the National Telephone Company to serve the two groups fairly. Now that being the case, it was perfectly natural that Col. Jackson should be rather shocked that a director of the National Telephone Company should run counter to the interest of the National Telephone Company as represented by the group that he is serving. But it was just as natural that he (Col. Williams) should be astonished that the chairman of the National Telephone Company should run counter to, or should sacrifice the interest of the National Company as he understood it; that he should sacrifice the interest of that group who had invested their money in it alone. Col. Williams then entered into the history of the amalgamation question, which he described as being introduced at one of the company's meetings three or four yeas ago, in a casual conversation, the outcome of which was that Col. Jackson was authorised to negotiate concerning the matter, and that when circumstances arrived at a stage when he could report anything definite to do so. Things remained in that condition till the first meeting of the company in January or February of this year. Col. Jackson then said that negotiations were taking some form, and, in all probability, before the next ordinary meeting he should have something important to communicate to them. He heard nothing more about the amalgamation project till he received a letter from Col. Jackson, dated 29th March, in which he entered into a very long account of the negotiations that had taken place, and what was proposed to be done. In that letter he said: "I do not know whether you will be sufficiently satisfied with these terms to give them your sanction, but I believe there is no means of obtaining better. However, I will leave this subject for oral discussion when we assemble on April 10th." Having alluded to other communications which passed between Col. Jackson and himself, he said that until some great compensating advantages could be shown by this amalgamation scheme, he was strongly opposed to coming into collision with the Post Office. At a friendly conference convened for the purpose of discussing what was to be done, another director, Col. Harrison, whom he had hoped to have seen present at that meeting, opposed the amalgamation scheme on the merits of the thing. Col. Harrison, who was one of the most competent men on the board, brought forward a number of figures by which he showed, as plain as figures could, that it would be a most disastrous thing for that company to enter into such an amalgamation as that proposed. His calculations were that by the time the United Company's patents fell out they would be able to reduce their tariffs from £15 to £9 or £10, and pay 9 per cent. on the ordinary shares of the company. Between that time and the present the scheme had never been before the board, and they knew nothing about it till the cut and dried scheme now proposed was forced upon them. As to the desirability of amalgamation, Col. Williams remarked that if any one would take a balance sheet and report of the United Company for 1888 and one of their company's and compare them, he thought he would see at once that the National Company was by far the more valuable of the two. The capital of the former company, speaking from memory, was in round numbers £450,000, and of that sum £350,000 stood on the books for patents and goodwill. The patents expire in about 18 months, and the goodwill was not worth more than that of the National. The capital expended in plant in the National amounted to £350,000, and in the United to about £200,000, so that the plant of the National was about half as valuable again as that of the United, even supposing the two companies' plants to be of equal quality. He knew nothing about the Metropolitan system, but unless he was greatly mistaken he had heard Col. Jackson say that it had been so badly laid that it would have to be relaid from end to end before effective service could be got from it. For these and other reasons he maintained that the bargain just being made to give 2¼ shares of the United Company to each one of the National was one of the most inconceivable things he had ever known in his life, and how anybody could propose such a thing to reasonable men passed his comprehension. If the amalgamation scheme came to anything he would sell his shares at any cost, and he would recommend everybody he knew to do the same.

Mr. W. A. Smith (Glasgow) supported the motion, and remarked that by the courtesy of the Post Office authorities he had been enabled to inspect two of their exchanges. There were only three or four throughout the country. The Newcastle exchange had been made the supreme effort of the Government, but he could assure them that it was a very poor thing, and that they had nothing to fear from any opposition in that quarter.

Mr. J. Garnett (Manchester) also supported the motion, and referred to Col. Williams's remarks to the effect that the negotiations had been conducted in a hole and corner, adding that Col. Williams had an invitation to go into the hole and corner and to see and hear everything that took place. He (the speaker) had done so, and was satisfied with the amalgamation scheme and with the arrangements, particularly so when the United Company said that they had been sold, and the Lancashire and Cheshire Company complained that they had not got as much as they ought.

The Chairman said that Col. Williams's facts would have been important had they been correct. He had talked of two financial groups and said that he had discovered, or been told, that the shares of the company were held mainly in a few hands. No single holder outside the United Telephone Company had above 1,500 ordinary shares excepting the bankers, and that bank held the shares of other people, and had sent proxies in accordance with their desire. Then Col. Williams had said that he had not had the opportunity of ascertaining what had been going on. At every meeting of the board he had entered into explanations on the subject. In obedience to a resolution passed by the board he had continued negotiations relating to amalgamation, and when they had arrived at some definite point he had taken the board into his fullest confidence. After denying several other statements contained in Col. Williams's circular, the Chairman concluded by remarking that he had not been as careful in obtaining the correctness of his facts as he ought to have been.

The resolution was then agreed to, with one disentient—Col. Williams.

On the motion of the Chairman, seconded by Mr. Bruce, it was resolved, "That the capital of the company be increased by the sum of £3,250,000, by the issue of 650,000 shares of £5 each."

The Chairman next moved, "That the regulations of the company be varied by substituting for the existing articles of association, the articles, a print of which is now submitted to this meeting, signed for verification by the chairman of the meeting and the secretary, and that such last mentioned articles be the regulations of the company in the place of the existing regulations."

This was seconded by Mr. Bruce, and agreed to.

The Chairman then moved a resolution appointing the board of directors for the amalgamated company, there being seven directors to represent the United Company, four the National Company, and four the Lancashire Company.

Mr. F. R. Leyland (one of the directors appointed by the United Telephone Company) seconded the resolution, and in doing so vigorously combated Col. Williams's remarks. Referring to his observations upon the chairman, Mr. Leyland said, looking point blank at Col. Williams: "According to what you said yourself, he (the chairman) is the man who has devoted the whole of his time, and has succeeded by his skill and assiduity in putting the National Company on its present prosperous footing, and this is the man you turn round and coolly charge with having sold the company. What do you mean by making this cruel accusation, unjust, and without one particle of foundation except in your own diseased imagination?"

Mr. J. A. Forbes having also spoken in favour of the amalgamation of the companies, the resolution was carried *nem. con.*

The Chairman next proposed, "That in order to give effect to the regulations of the company all the directors holding office on the board, on their adoption, be removed from office."

This was seconded by Mr. Sands, and adopted.

The proceedings terminated with a vote of thanks to the chairman.

## Consolidated Telephone Construction and Maintenance Company, Limited.

THE eighth annual general meeting of the shareholders in this company was held on Thursday last week at the Cannon Street Hotel, under the presidency of Mr. C. L. W. Fitzgerald.

The Secretary (Mr. Charles Curtoys) read the notice convening the meeting, and the report of the directors, published in the REVIEW for May 24th, was taken as read.

The Chairman: It will be in your recollection that last year, in February, the board terminated the contract for the manufacture of telephones which had been running with the American Telephone Company for some four years. We did not do so very badly under the contract, but I have, I think, to congratulate the shareholders on the fact that we have done a very great deal better this year. Later on I will tell you how much better, but I think I must say that the reason no doubt that we have done better is that we have looked into the question of manufacture more closely than when we were dealing with the contractor who simply sold us the instruments at a fixed price, and which we sold again. Leaving the figures to the last, I will deal with the report as it is laid before the shareholders. The profit, you will see, for the year, with the balance which we brought forward, amounts to no less than £13,286 for disposal, after making provision for doubtful debts. The board proposes to deal with this sum by paying a dividend at the rate of 7 per cent. for the half year—making, with the interim dividend paid in November, 6 per cent. for the year—and writing off £520 for depreciation of plant, machinery, and furniture, and the sum of £2,000 off goodwill and patent rights, leaving a balance of £1,558 to carry forward. The action in Belgium is still dragging along, I am afraid I must say. When once one gets into law it is a very slow matter, but I can inform the shareholders that so far everything has gone in our favour. That, I think, is a great point, and we have now reached the stage when the question is to be put into the hands of experts to decide whether any infringement of our instrument has taken place or not. Of course, in my own mind, I have not the shadow of a doubt that it has, but as we are dealing with a foreign Court it is not possible for us to say what the issue will be. We must, however, hope that it will be a favourable one. I now come to the question of the factory. I think I never was more pleased with the way things are going on at the factory than I am at the present moment. I find that everything goes on smoothly. I have not said previously very much about what we have been doing at the factory, but you must not imagine that we are standing still there. On the contrary, we are making improvements—I may say immense improvements—in the instrument we are turning out; and we are also making great improvement in our machinery in the way of making parts of the instruments with labour-saving machinery—a proceeding which saves very considerably in the expenses of manufacturing. It is very gratifying to us to find that we are enabled to do that, and that our profit from the manufactory has been £4,000 more than it was in the previous year. In other words, last year we had a profit of £5,773, whereas this year we have a profit of £9,784. I think that it is very satisfactory to us to see that we have made nearly double the profit of the previous year, and I only hope that in the next year the profit will be trebled. There is really very little for me to say to you about the figures. I think this balance sheet may be said to be a fairly intelligible one. You will see that we have received in interest from various sub-companies, dividends on shares, &c., £2,371, and that we have received £3,044 from the liquidators of the River Plate Telephone Company. We have done all that we can to keep down the expenditure, and I think I may say that we have very fairly succeeded. Considering that the profit shows so large an increase, I do not think the increase of expenditure has been so much. In the first item, at least, the increase is only £60. I think I need say very little except in so far as our plant and machinery are concerned. They are all in perfect working order, and we have reduced the value in the balance sheet by a very considerable amount. The stock of instruments has increased a little, but that is very natural with our doing a larger business. The item last year was £4,719, and it is now £6,453. The amount owing to us, it is rather gratifying to find by the balance sheet, is £6,381, against £8,072 last year, while we owe, on the other hand, only £1,459, as against £2,025 last year. I think those figures ought to be considered satisfactory by everyone. As to the question of the relationship between the United Telephone Company and this company, I am happy to state that it is very cordial indeed: in fact, there is no doubt about it that we have had a great deal more business from the United Company, and I am gratified to be able to state that it seems to me likely to increase. We now have a very considerable number of orders on hand to execute, and as far as I can judge, looking around England, I think the business is likely to increase very considerably. You see an item in the revenue account, "expenses in connection with the Lisbon Exhibition." That is a very small item—only £33. We exhibited some instruments there, and only this morning did we receive a telegram from Lisbon from the managing-director of the Anglo-Portuguese Telephone Company, stating, "Have received flattering letter regarding instruments exhibited by Consolidated Company from the Committee of the Lisbon National Exhibition. Being a foreign exhibit, medal could not be awarded." In other words, as we were foreigners they could not give us an award, but they gave us great praise for the instruments we sent to them. Now, gentlemen, I come to the subsidiary companies. I think it is most gratifying to find that year after year (this is now the fifth year) we are going on seeing an increase in the rental of those companies. This year there has been an increase of no less than 618 in the number of subscribers, while the increase in the rental has been £3,410. It is in connection with these sub-companies that the directors have offered to the shareholders—or will offer to them—the 15,000 preference shares out of the 75,000 which are to be created. I may tell you that in 1884 the income from those companies amounted to only £10,000, and that £10,000 was practically absorbed in working expenses. The gross annual income from those companies has now reached a sum of no less than £26,500, and their net income was for the past year £11,050. From that sum we have to deduct the debenture interest and the preference interest of those companies, but after that there is left a net balance of earnings by those companies of £7,200. At present the whole of these earnings are expended in construction. You will readily understand that to put up a telephone to earn an annual subscription costs a considerable sum of money, and as we find that no sooner is one man supplied than another wants to have similar advantages, the result is that all our net profit is absorbed in putting people on the telephone as fast as ever we can. It is for that reason that we have proposed to issue these preference shares. The idea is this: We issue 15,000 preference shares to the Consolidated shareholders, and we hand on the money to the subsidiary companies, taking from them securities which will pay us 6 per cent. or more, thus bringing us back the money which we should have to pay on our own preferences. By doing that we shall give these companies capital to enable them to free the revenue which they get every year, and which keeps on increasing, and with that revenue free they will be enabled to pay us dividends. It appears to me that the proposal is of the very greatest advantage to the shareholders of these companies. I have always told you that I looked for very great results from the subsidiary companies paying us dividends. You see we receive already £2,700 from them. Of course it is only an estimate, but I estimate if we carry out this issue of preference shares that we shall get, to begin with, £3,000 more, and that sum will go on steadily increasing as the companies grow. I hope, of course, that the shareholders will support us in this scheme. I shall feel very gratified if they do, and I can only say that we, the directors, will do all we possibly can to keep up the state of efficiency which the company has been brought to. If any gentleman has any questions to ask before I put the motion for the adoption of the report and accounts and the payment of the dividend, I shall be happy to answer them.

Mr. Perrin said he saw that the United Company was to be absorbed by the National Company, and he asked whether the absorption by the latter company of the Consolidated Company's customers would lessen the sale of their telephones, and whether the company supplied the National Company?

The Chairman: The agreement which we have with the United Company will be simply handed on to the National Company. We already supply the National Company. We supply the whole of the companies in England, and therefore it will not make the slightest difference to us. In fact, to tell you the truth, I think we shall probably benefit by it. I see that there is a great possibility of this amalgamation extending the business very largely, and that means more instruments to manufacture. I have now to propose—"That the statement of accounts and balance sheet and the report of the directors as now submitted to the meeting be received and adopted, and that a final dividend of 7 per cent. for the half-year, making, with the interim dividend previously paid, 6 per cent. for the year ended March 31st, 1889, be paid."

Sir A. Armstrong, K.C.B., seconded the motion, which was carried unanimously.

The Chairman next proposed the re-election of the retiring directors, Mr. J. H. Buckingham and Mr. Richard Van Zellar, who, he assured the shareholders, were excellent servants of the company and valuable members of the board.

Sir A. Armstrong, in seconding the motion, endorsed the remarks of the chairman.

The resolution was carried unanimously.

On the motion of the Chairman, seconded by Mr. H. Grewing, Mr. J. G. Griffiths was re-elected an auditor to the company, the Chairman stating that he was very much satisfied with the way in which Mr. Griffiths kept the accountant up to his work.

Mr. Raines afterwards moved, and Mr. Gardiner seconded, the re-election of Mr. A. E. Green, the other auditor, and the motion was also adopted.

The Secretary then read the notice convening the extraordinary meeting, the advertisement stating that the following resolutions would be submitted:—"That the capital be increased to £307,545 by the creation of 75,000 new shares of £1 each." "That the new shares be called preference shares, and that the holders thereof be entitled to a preferential dividend at the rate of £6 per cent. per annum, payable out of the profits of each year, without any right in case of deficiency to resort to the profits of subsequent years." "That the holders of the said preference shares shall be entitled on any distribution of the assets of the company to be repaid in the first place the amount paid up on the preference shares held by them respectively, before any payment out of such assets to the other members of the company."

The Chairman: I do not think, after the explanation that I gave, it will be necessary for me to go over the ground again, and therefore, if it is your pleasure, I will simply put this resolution to you as a whole. We might take them separately, but I think it would be quicker to take them as a whole. He accordingly proposed the resolutions as one.

Sir A. Armstrong seconded the motion.

Major-General Westropp said that it was now proposed to increase the capital of the company, whereas two or three years ago the capital was reduced by a return of 1s. a share to the shareholders, and some time before that the capital was reduced from 20s. a share to 15s. a share, the shareholders being mulcted of the 5s. If they were now to increase the capital of the company he would like to know why they had received that shilling back. Would it not have been more useful to have kept it for the purpose for which money was now required.

Mr. Leatherbarrow asked whether the directors were satisfied with the securities they would receive from the subsidiary companies for the proposed advance to them of the £15,000.

The Chairman: The first question was as to a quotation on the Stock Exchange. Until we have absolutely issued 50,000 shares no quotation could be granted on the Stock Exchange. I now come to the question about the return to the shareholders of 1s. a share. Of course, if we had kept that shilling we should have had money to advance to our subsidiary companies, but I confess I cannot see that it makes very much difference. It occurs to me that having given you back that shilling we have paid the shareholders a great deal more dividend on the 14s. remaining. As to the 5s. that was deducted, that was a different matter altogether. That event occurred before this Board came into office, and that was money that was lost by our predecessors. In the one case the shares were reduced by 5s. because that money was lost, and in the other case we returned them 1s. a share. It appears to me that there is a great deal of difference in the two proceedings. If the old Board had returned you 5s. instead of losing you 5s. that would have been doing what we have done. The other question asked was whether the Board are satisfied that we are going to get securities from the sub-companies which will be dividend-paying securities. Of course we are, or we should not propose what we are going to do. It is true that we hold a large portion of the debentures of these companies, but they have preference shares and ordinary shares which will pay dividends, and that will pay us a return on the money we propose to advance.

Major-General Westropp thought that before the capital of the company was further increased the directors should try and return what the former Board had taken away, and so make the shares their original value.

The Chairman: I do not think that that is possible or practicable. We have no capital to return. If you would like to have no dividends and receive the money back in that way you could get it; but I see no other way.

Mr. A. H. Pinto stated that as the directors proposed to issue preference shares the ordinary shares would be affected, and he therefore asked if the holders of the ordinary shares would be afforded the opportunity of exchanging them for preference shares.

The Chairman: We have very carefully considered this. It has not been done hastily, but we could not, of course, do what this gentleman suggests. There would be no object in it. In my mind, this proposal of ours is going to increase the value of the ordinary shares—that is my object—and not to depreciate them. He then put the motion, which was carried unanimously, and he subsequently announced that the dividend warrants would be posted on or before Tuesday.

Mr. Buck proposed a vote of thanks to the chairman, observing that the shareholders ought to congratulate themselves on having such a gentleman to preside over the interests of the company. He (the speaker) was an original shareholder, and he felt very much gratified at finding that the present board was discharging their duties so satisfactorily to everyone.

Mr. Heyer seconded the motion, which was carried unanimously.

The Chairman: Gentlemen, I am very much obliged to you. As long as I possibly can you may be quite sure that I will watch over your interests and do the best that any man can do for you. I cannot say more than that.

The meeting then separated.

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## The Electrical Automatic Delivery Box Company, Limited.

THE second ordinary general meeting of this company was held at Winchester House on May 30th, Major R. H. Murdoch, chairman of the company, presiding.

The Secretary read the notice convening the meeting.

The Chairman, in moving the adoption of the first annual report, said: The extraordinary meeting held last month was called to ask your judgment as to the expediency of effecting an amalgamation with the Automatic Trading Company, or of selling the assets of the company should that fail, and you approved of the expediency of the former course. Amongst the conditions on which we consented to enter into the details of amalgamation with the Automatic Trading Company we first required notice of what their liabilities would be. We spent many hours and many days during the course of the month in investigating all the ins and outs of their ledger sheets, their diaries, the whole liabilities and assets of that company, and I think we are as well posted in the affairs of that company, possibly, as they themselves are. We were perfectly willing to effect an amalgamation, but it must be on the distinct understanding that we should not take over any liability for royalty beyond that on 200 boxes, and that the royalty which they were paying, of £3 per box, should not exceed £1 10s. per box. To that they consented, and they satisfied us that there was a reasonable prospect of that arrangement being concluded.

Mr. Macbeth's boxes are used by the Automatic Trading Company to the extent of 100. I believe they are the only company in London who use the Macbeth boxes; and at the last meeting Mr. Macbeth was unable to make that concession because of his having sold the whole of his interests to a variety company, which insisted upon something like 600 boxes at a royalty of £3. We were perfectly satisfied that no automatic trading company in existence could possibly live with such an arrangement as that, and we declined to venture any of our shareholders' interests into that matter at all. The amalgamation is not finally rejected; we, on our side, have approved of the principle. We are perfectly prepared to-morrow, if they can effect it, to effect an amalgamation on our stipulation; and at an extraordinary meeting their shareholders approved of it, which was—equal terms, like for like, each to share. Unless our terms can be complied with, we certainly had better not have anything to do with effecting the amalgamation; but when they are able to do it, we shall go on. At the same time, that will not affect us; finding that there was likely to be a hitch with the amalgamation we resumed negotiations for sale to the Sweetmeat Automatic Company, and while we were met in the extraordinary meeting last time, the chairman of that company sent me a message to say that if the amalgamation with the Automatic Trading Company should break down he was quite prepared to be open to make his offer again to us. That offer was £7,000, which would, we reckoned, give us something like 5 per cent. The day after the extraordinary meeting, so as to keep two threads going lest one should tumble down, I resumed negotiations with the chairman of that company, and I have his letter here consenting to the sale, but no sooner did he find that we had broken off the amalgamation, in consequence of a hitch, than he began to higgle down the terms by a thousand or two, and we said we would not waste our time or it might be late in the summer before we could do anything. We said: "You shall either pay us £7,000 down now and we will carry out the sale, or, if you are going to delay and waste time, we will not enter into any further negotiation with you." To that we received a reply saying that the sum was out of the question, but that in a week or two the chairman would be prepared to resume further negotiation, and that is how it stands at present. It is not closed; it is still open, but their policy is this, that if they find we are at all disunited, or that we are liable to go to the wall, they will bide their time in order to get us as cheaply as they possibly can. If, on the other hand, they find that we mean to be rivals, I think we shall not only effect a sale, but, I am perfectly certain, make a better arrangement than we ever anticipated. But I should undertake to say when we get our electrical boxes at railway stations, that, within three months from that date, the public will cease to have anything to do with their boxes and they will come to us. It is injudicious, it is inexpedient to tell you now what is the secret of this, but it is very obvious to those who are acquainted with it. Well, gentlemen, the accounts are now before you, and we shall be pleased to answer any enquiries upon them to the fullest extent; nothing has ever been concealed by us. As regards the liabilities, we have not incurred a penny of liability; we have simply taken over, as legal liabilities, those which were incurred by the former board. I am very happy to tell you now that things have altered for the better very much beyond our anticipations. When we came into office, about the end of January, we were met with a direct negative everywhere, from railway companies, steamboat companies, and other owners of public places; we could not get a footing to stand on. Some little straws which showed clearly which way the wind was blowing enabled me to ascertain that the policy of some of the railway companies and others was being altered, and that a very fitting opportunity had arrived for trying to get the thin end of the wedge in, and, privately and officially, we reopened negotiations, and although it is most inexpedient that the public should get wind, by any public statement of mine, as to how things stand, I am very happy to tell you that there is an almost certainty of our immediately getting, not only one, but possibly two or three railway positions for this company, and we shall be able to put our boxes at those stations as fast as the stations are available. At the present moment one of the board, Mr. Deakin, is engaged in a most delicate negotiation which is most favourable, and almost certain to give us a large concession, and we have not wasted any time with regard to this. In our negotiations for amalgamation and sale, we were under injunctions against utilising the capital of the company, and consequently we dare not enter into any liabilities; but the moment we got the release, after the last extraordinary general meeting, we entered into most favourable negotiations with Mr. Ingray. The terms Mr. Ingray gave us in January were absolutely impracticable; they virtually amounted to this, that we should take one-third of our capital and hand over to him cash for the delivery of boxes; we could not do it. Now we have been able to get an arrangement made with Mr. Ingray by which we can get boxes at what may be termed self-paying prices, *i.e.*, we shall not have to pay for them much more than a bagatelle every month, something like on the hire system, a most favourable arrangement, so that instead of incurring an immediate payment of upwards of one-third of our cash capital for boxes, we shall only have a small trifle of about £100 to get 100 boxes, £150 when we have got the 100, and about 30s. per month to repay. In the meantime, the whole internal mechanism of the box has been altered. At present when any one of our three columns gets out of order, the internal works being part and parcel of the carcase, it necessitates either the whole box with the mechanism being removed to the works, a costly process, for repair, or that a skilled mechanician should go to the railway station, or wherever the box may be, and, at the total cessation of the trading of the box, repair the column or columns that have got out of order. Under the principle which we have so far approved and which has met with the warmest approval, I understand, of Mr. Stead, the electrician—we have not got it in writing yet—the mechanism would be a separate part from the carcase, and, should it get out of repair in one column, it can be detached and carried to the works by a boy, the other columns going on trading all the same. I submit to you that this arrangement is infinitely more preferable to the other, much more economical, and is bound to be successful. With regard to the balance sheet, the capital is virtually as it was. The utmost endeavours have been made to economise expenditure. A considerable reduction in rent has been made. The directors receive no fees: personally, it costs me something like 6s. 6d. every time I attend a Board meeting, but having put my hand to the plough I will not turn back in the day of battle. We three directors are quite united and do not mind all the trouble we take or what amount it personally costs us; if we can once place this boat into deep water, fairly rigged, and wish it a prosperous voyage, then you can get rid of us as soon as you choose.

The adoption of the report and balance sheet was then moved by the Chairman and seconded by Mr. Tom. Evans.

Mr. Painter asked whether the value of the 3,065 forfeited shares, upon which £155 5s. had been paid, was totally irrecoverable; also, what was the amount of cash in the bank on deposit. He held 3,000 shares.

The Chairman replied that most of the forfeited shares were bogus applications and irrecoverable. The total cash capital was very nearly £3,000, which was ample to develop the company to such an extent that would more than pay all fixed charges, if not to leave a dividend.

The motion was unanimously carried. The retiring director, Mr. A. Deakin, was re-elected, and Mr. Painter was appointed auditor. The meeting then closed.

## The Lancashire and Cheshire Telephonic Exchange Company, Limited.

THE report of the directors, to be presented to the shareholders at the eighth annual ordinary general meeting of the company on Tuesday, June 11th, 1889, at 11 a.m., in the Memorial Hall, Albert Square, in the City of Manchester, states that they have the pleasure to submit a statement of accounts, made up to the 30th day of April, 1889.

The accounts only comprise a period of 10 months, and the subscriptions and rentals pertaining to that period amount to £80,393 9s. 5d., as compared with £89,797 5s. 10d. for the 12 months ending 30th June, 1888.

The amount of income carried forward, as representing sums received in advance, for periods extending beyond 30th April. 1889, is £45,599 10s. 8d., against £40,377 3s. 5d. in previous year's balance sheet.

On the 10 months' working the profit is £29,586 15s. 8d., which, with a credit balance of £1,534 8s. 4d. remaining from previous account, makes a total of £31,121 4s. After deducting from this sum interest, bank charges, interest on reserve fund, and the interim dividend paid in March last, there remains a balance of £14,983 15s. 11d. The directors now recommend a dividend at the rate of 8½ per cent. per annum for the 10 months ending April 30th, 1889, from which will be deducted the dividend already paid in March last (calculated at the rate of 7 per cent. per annum), in respect of the half-year ended December 31st, 1888. This will absorb £13,222 4s. 6d., and leave a balance of £1,761 11s. 5d. to carry to the reserve fund.

The total number of subscribers on 30th June, 1888, to the various "exchanges," was 4,103, and of private lines 1,430; this year, at 30th April, the figures were 4,422 and 1,556 respectively.

**Brazilian Submarine Telegraph Company, Limited.**—The directors of this company have declared an interim dividend of 5s. per share, free of income tax, for the quarter ended March 31st last and payable on the 24th inst.

## TRAFFIC RECEIPTS.

The Brazilian Submarine Telegraph Company, Limited. The traffic receipts for the week ended 31st May amounted to £3,960.

The Cuba Submarine Telegraph Company, Limited. The estimated traffic receipts for the month of May were £3,800 as compared with £3,337 in the corresponding month of last year. The receipts for the month of February, estimated at £3,298, realised £3,204.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of May were £2,640, against £1,800 in the corresponding period of last year.

The Great Northern Telegraph Company, Limited. The receipts in May, 1889, £22,800; January 1st to May 31st, 1889, £106,800; corresponding months, 1888, £108,400; and of 1887, £103,520.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending 31st May, 1889, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,835.

The West Coast of America Telegraph Company, Limited. The gross earnings for the month of May were £6,975.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 31st May are £3,078, as compared with £2,978 in the corresponding period of 1888. The February receipts realised £6,051.

## LONDON COUNTY COUNCIL AND ELECTRIC LIGHTING.

*Proposed letter to the Board of Trade, referred to in the report of the Highways Committee presented to the Council on June 4th,* 1889.

SIR,—The Council has had under consideration your letter of March 13th last, in which, referring to the electric lighting schemes of the present session, you express the wish of the Board of Trade to be furnished with any observations which the Council may have to offer upon the large and very important question of the future of electric lighting in London, and you refer especially to two questions of principle which have arisen in relation to the matter, viz. :—(1) What should be the extent and nature of the area to be granted ? and (2) Should or should not concurrent powers be granted to two or more companies within the same area. The Council has also considered the further letter from the Board of Trade, dated May 18th, forwarding copies of a report by Major Marindin, R.E., on the result of his inquiry into the applications for Provisional Orders and licenses under the Electric Lighting Acts, 1882 and 1888, as well as into the subject matter of the Bill introduced into the House of Commons by the Metropolitan Electric Supply Company.

The Council has directed me to submit the following suggestions and observations for the consideration of the Board of Trade, when dealing with the electric lighting schemes affecting the County of London.

The Council agrees that extensive areas may properly be granted to companies when their financial and technical means of carrying out the powers entrusted to them are of a satisfactory character, and accepts generally the recommendations of the report as regards the districts to be allotted to the several companies.

The Council considers that in the interest of the public, competition is desirable under proper restrictions.

The Council is not prepared to offer any opinion or suggestion with reference to the scientific or technical portion of the report, but desires to express its full concurrence with the recommendation in Major Marindin's report that a company supplying a large area without a reserve of current should be required to provide duplicate sets of generating machinery in separate buildings, and duplicate sets of mains, in order to secure a proper and continuous supply in case of a breakdown of machinery or other default ; and further, that every possible means should be taken for guarding against danger to the public from currents of high tension.

The Council concurs in Major Marindin's suggestion (2) that certain streets should be scheduled in each district for the compulsory laying of mains, and that the supply in the remainder of the area should be made compulsory, upon requisition of consumers, on fair and reasonable conditions ; and suggests that in case of such supply not being afforded after a sufficient interval of time, the order should be revoked as regards the whole of the parish or district in which such default occurs. It appears to the Council that without such a provision being made a company might be in a position to supply those parts of a parish or district where there was a good demand, and to leave unsupplied those parts of the area in which the demand was limited. The Council further suggests that the companies should be required, in all streets where mains are laid, to bring the supply at their own cost to the consumers' premises.

The Council concurs in the suggestion (6) in Major Marindin's report that wherever a company now supplying a district by means of overhead wires is granted an order for such area, the company should be placed under statutory obligation to remove these overhead wires within two years from the granting of the order, and that if possible such company should be prevented from invading a district, in which it has no statutory powers, by means of overhead wires ; and the Council suggests that it should be an indispensable condition of the granting of any application for an order or licence that in the area referred to therein all wires and mains should be laid underground.

With reference to clause 55 of the London Company's order, which would enable the company to supply electricity to a Vestry or District Board for the latter to retail to consumers, the Council considers the expediency of granting such a power to be doubtful, and would suggest that, if allowed, a provision should be inserted that the power given by the clause shall in no case be acted upon without the consent of the Council having been first obtained.

The Council also submits the following general suggestions, applicable to all the orders and licences, namely :—

(*a*) That the terms and conditions of all orders or licences granted should be as nearly as possible identical.

(*b*) That companies should be required not only to make use, with the consent of the Council, of subways now made, or which may hereafter be constructed, in streets where mains are to be laid, but to pay a fair rent for such use ; and, further, that in case of subways being in future made in streets where wires are already laid, the companies should be under an obligation to remove the wires into such subways and to pay a rent for the use of them, a reasonable time (say three years) free of rent being allowed as a set-off to the cost of such removal. That the power to make subways in the London streets should be vested in the Council, and not in the local authorities of the several districts.

(*c*) That provision should be made to prevent the opening of any thoroughfare in the county of London for the purpose of laying mains, &c., until the consent in writing of the Council shall have been given to such opening.

(*d*) That provision should be made for exempting the Council and the vestries and district boards from liability in respect of any damage which may be done to mains, &c., in carrying out works of repair or improvements in streets or roads, or for the use of steam rollers in the execution of such works.

(*e*) That provision should be made for preventing interference with main or local sewers, or with the proper access to them, without the consent of the authorities in which such sewers are [illegible]ted ; and that plans of works which would interfere [illegible] sewers in any way should be submitted for the approval of such authorities before the works are begun.

(*f*) That, in view of the future possible reduction in the cost of production which may be made as the result of experience and invention, there should be a provision that the maximum price of 8d. per Board of Trade unit proposed to be adopted shall be subject to revision at the end of seven years ; and that in order to ensure healthy competition between the companies during that period, (1) no amalgamation or working agreement between companies should be permitted without the consent of the Council, and (2) power should be given to the Council, at the request of a vestry or district board or on the requisition of inhabitants in any street or district, and with the consent of the company interested, to extend the area of such company to such street or district, without the necessity of obtaining another order.

That clauses should be inserted providing for the application at the end of the seven years of a sliding scale of price and dividend, on the basis of a dividend of 8 per cent., leaving the initial price and arrangement of the scale to be determined at the expiration of the term of seven years.

That provision should be made that electricity supplied to local authorities for the purpose of public lighting shall be charged for at a less price than that charged to private consumers.

That the minimum charge for supply should be fixed as low as possible ; and that should such minimum be fixed at £1 per quarter, or over, it should be reckoned by the year, and not by the quarter, because of the irregular requirements of the consumer at different seasons of the year.

(*g*) That for the purposes of purchase by a public authority any additions made to the area of supply of any company shall be taken to be part of the original area granted to such company, and that the powers over the additional area shall terminate at the same time as those over the original area, unless at the time the additional powers are granted to the company it shall be expressly stated to the contrary.

The Council considers it would be to the advantage alike of the public and the companies that there should be one uniform system of regulation and control throughout the entire area of London. The necessity of this was forcibly illustrated by the very varied, and in many respects inconsistent, objections and requirements of the different vestries and district boards in regard to the proposed orders, and by the complication and difficulty occasioned thereby.

The Council is of opinion that, as the representative governing body of the whole of London, it should be appointed the controlling authority. It would always receive and give the fullest consideration to the representations of any local body on questions affecting its particular interests. It would remind the Board of Trade that the main roads throughout the Metropolis will shortly be under the jurisdiction of the Council, and, should any general system of subways be hereafter resolved upon, such system will also be under its control. The Council considers, also, that it should be the authority to whom should be given the power of purchase in all cases at the expiration of the specified period; it would be manifestly impossible for any single Vestry or District Board to purchase a large undertaking supplying many parishes, such as that of the London or the Metropolitan Company. The Council would further suggest that if it is made the controlling authority it should be empowered to discharge the following duties, viz.:—

Inspection of lines and works.
Testing current.
Testing and certifying meters.
Taking proceedings for imposition of penalties or forfeiture in cases of default as provided in the orders.

And in order to carry out the work of testing it should be made obligatory on the companies to provide and maintain sufficient testing stations, and proper and efficient testing apparatus.

The Council, in view of the fact that some companies have been, and are now supplying electricity by overhead wires, without statutory powers, and being convinced of the undesirability of allowing this to be continued, would venture to suggest that in any future legislation on electric lighting the supply of electricity in any district before obtaining statutory powers for such district should be prohibited under penalty.

The Council, in submitting the above suggestions, is animated by a desire to facilitate the working of the companies' undertakings in the various areas to be allotted to them, and at the same time to insure that the interests of the public are properly guarded; and the Council thus submits its views in the full assurance that they will receive due consideration from the Board of Trade.

Some of the orders will affect the bridges, embankments, and other works under the jurisdiction of the Council; but the Council reserves any expression of opinion upon the manner in which its interests should be protected, as also upon other general matters of detail, until it shall have received the copy of the model order referred to in the letter from the Board of Trade of May 18th.

I am, Sir,
Your obedient servant,
H. De la Hooke,
*Clerk of the Council.*

The Assistant Secretary, Railway Department,
Board of Trade.

**Telegraphy in Spain.**—The Spanish Minister of the Interior has proposed to the Cabinet to reduce the rates for press messages at certain hours of the day.

## COMPOUND WINDING PATENTS.

King, Brown & Co., *v.* Anglo-American Brush Electric Light Corporation, Limited.

*(Continued from page 634.)*

Mr. Jameson rose to speak on behalf of the defenders in the absence of Dean of Faculty Balfour, who was detained in London. Mr. Jameson began by stating that he should endeavour as clearly as he could to follow the order taken by his learned friend in his very lucid speech. The question which they had first to consider was about the commutators, and in regard to that matter it was, in the first place, necessary that they should clearly understand that that invention, so far as it related to the commutator, was not an invention of a new article. Long before Brush's time commutators were both known and used. It was not a new application of electrical principles, nor was it a proper electrical invention at all. It was a pure invention in the mechanical appliance or form of commutator, and, as they submitted, an invention both of utility and novelty. The first matter of importance which he would notice was that there was a large insulating hub, not a mere ebonite collar, as in the other case, between the metal of the shaft and the metal of the commutator, which had the effect of effectually insulating every one of the wires from the shaft, and insulating them from one another. Upon the top of the insulating hub they had sub-segments of a particular model. All these were brought in close electrical connections with the wires which came up under each of them and maintained the electrical connection. These were screwed firmly on to the hub not being intended to be removed, and the screw was of a very peculiar form, which might be said to be all head. The result of that was that although some of the wires wore, there was always a head to keep the wearing segments on the sub-segments. In short, it had a head as long as there were any wearing segments to hold down. There was a very considerable advantage in the head commencing immediately outside the sub-segments, because, however far it was worn away, all that was done was to make a catch with a screwdriver and unscrew the screw. He submitted that, as a whole, the invention was one of great utility and novelty. It was an invention which, looked at as a mechanical contrivance, needed some skill and work to think out and complete in its present form. Having made these general observations, he proceeded to deal with the objections which had been taken to the invention by the other side. The first objection was that there was a claim in the final specification which was not covered by the provisional specification, and that was founded on the statement that according to the final specification it was disclosed that the commutator was so made as to cut out the bobbins by means of insulating segments or spaces, and that that idea was not foreshadowed in the provisional specification. To that he answered that there was no claim for cutting out the bobbins. There was a claim for a commutator of a particular form, which would have the effect of cutting out the bobbins, but that did not make it a claim for a commutator which should have that effect. The claim still remained for a commutator of a particular form, having that cylindricity, easy removability, and simplicity of construction. The fact that by using a commutator of that particular mechanical construction they got that result, did not make that a part of the invention which they claimed. He proceeded to contend that what was claimed in claim 6 was simply a mechanical improvement dispensing with one of the sub-segments, T.

Lord Trayner asked if the defenders' second claim in the amended specification was not co-extensive with the provisional specification.

Mr. Jameson replied that he thought so.

Lord Trayner said that then the defenders had claimed in the second claim all that they foreshadowed. Claims 3 and 4 must be something that they did not foreshadow.

Mr. Jameson replied that they foreshadowed something else than was claimed in the claim.

Lord Trayner asked where in the provisional specification they foreshadowed claims 3 and 4 of their amended specification.

Mr. Jameson said that the combinations had for their purpose the keeping of the commutator cylindrical.

Lord Trayner: But the insulating segment, T, has nothing to do with the keeping of the cylindricity.

Mr. Jameson admitted this, and said the function of the provisional specification was to describe with the greatest generality what had been done. It was not intended to ascertain the entirety of the invention, but the identity of the invention, so that the law officers might know what was to be the subject matter. The great point made by the counsel for the pursuers was that by constructing a commutator with a space like that submitted, the defenders were doing away with the wearing segments altogether, and were therefore not within their provisional specification, so that there was nothing in claims 4 and 6. But that was really what might be called a note to the claim, and not a description of the invention. Mr. Brush carefully distinguished in the specification between the construction and the function which each segment had to perform. It was out of the question to insist that a piece of information telling people that they might, if they chose, leave out T was to invalidate the claim. The people were merely informed that if they chose to use the other parts of the commutator they would dispense with the T section. That was the reason why they claimed the integers. If they had not done so, bit by bit of the commutator might have been stolen and used otherwise. The other side had argued that this was not a patentable invention because it was not novel or useful, but there were a number of cases in which very small inventions had been held to be patentable. Having referred his lordship to a number of these, Mr. Jameson said that taking the description in the specification and viewing the machine itself in comparison with the other machines—apart from the question of anticipation—it had, he maintained, been shown to be a really admirable mechanical contrivance, embodying, as American inventions generally did, neatness of detail and ingenuity. It had always to be remembered that a difference had to be drawn between the mere mechanical construction, which was all that was claimed, and the object which the inventor had in view. What they really claimed was that particular piece of mechanism, and he submitted that it was a useful and good piece of mechanism, rendering it patentable if it had not been anticipated. On the question of anticipation, he held that the Wilde commutator had no insulating hub at all.

Lord Trayner pointed out that in the provisional specification it was called an insulating hub or body.

Mr. Jameson said it certainly was a body, but it did not insulate the commutator, while Hadden's patent did. He was of opinion that the word "body" in the specification was used as a synonym for hub.

Lord Trayner did not think that could be because it was disjointed. If he were dealing with a mere construction of language and not with a patent case he should read it as meaning an insulating hub, or any other body that had insulating power.

Mr. Jameson submitted that it was merely exegetical. He proceeded to say that it was enough for him that Wilde's commutator had no insulating body, but only a body which insulated one-half of the commutator and no more, the other half being fixed on the shaft. As a consequence, there was only one commutator that could be put on the shaft, while Brush allowed any number to be put on the shaft, because all the wearing segments were on the hub. Then the wearing pieces in Wilde's were screwed by only ordinary screws from the inside, instead of from the outside, as in Brush's.

Lord Trayner asked if the screw was of any material value, because the defenders did not claim any particular screw.

Mr. Jameson submitted that they described it and claimed it in conjunction with other things.

Lord Trayner: Could you prevent anybody from using the screw?

Mr. Jameson replied that they could prevent them using it in conjunction with their segments. He maintained that the screw enabled the commutator to be easily detached, and they had the great advantage in Brush's patent of having an easily detachable wearing segment. The second Manchester commutator had the screw differently inserted, and did not give the cylindrical wearing substance which Brush effected by having the screws put in and then turned flush with the segment. On all these grounds he submitted that Wilde's commutators could not be taken as anticipators of Brush's commutator. They were totally different commutators, except that they performed the same function. It was perfectly clear, with regard to Varley's commutator, that it was never published, unless Varley's machine was used instead of, as he held, being merely experimented with.

Lord Trayner remarked that the case for the pursuers on that point was that Varley's commutator had nothing uncommon about it at all, but that it was a common commutator in all at the time, and that the defenders' commutator was nothing different in effect or in character from the commutator that was used by Varley.

Mr. Jameson admitted there was nothing different in electrical effect, but in mechanical utility there was a great difference.

Mr. Jameson proceeded to show that Varley's commutator was not an anticipation of Brush's, because the wearing segments were not detachably-attached. It had not been proved or shown, he said, that in any of Varley's commutators there was any of these arrangements of the insulating segments, or other things, such as they had in Brush's.

Lord Trayner: You have certainly not in Varley's commutator an insulating segment, T, so that if the insulating segment, T, is part of your foreshadowed invention, it is a different thing.

Mr. Jameson: Apparently there was a hub of some sort, or an insulating body. Whatever may be said about the machine otherwise this part of Varley's commutator was never published or known.

Lord Trayner: The case about the commutators stands thus, that the Brush and Varley commutators were quite common. The only question is, is the commutator described in your provisional specification and as finally claimed, assuming it to be well-known is it—mechanical as you put it, or electrical as they put it—different from the commutators in use.

Mr. Jameson said, of course they held it to be mechanical.

Lord Trayner: But was yours mechanically different in such a way as to make it patentable?

Mr. Jameson pointed out that there were the wearing pieces screwed on, and the wearing segments extending to and filling up the gap in the next ring, which were also the wearing segments of that ring; the cylindricity, the peculiar form of the screw, and putting in screws from the outside so as to make them easily detachable, and the peculiar form of the hub, all these things would make it patentable. The next question to which he turned was more important, viz., the one of the compound winding. While it was true, as his learned friend had said, that possibly Brush no more than Varley—supposing Varley had any clear idea on the subject—knew what a valuable application was to be afterwards made of compound winding; yet the specifications were totally different in one way. Brush, however, knew what he was about, because, although he was not seeking for what, strictly speaking, was known now as constant potential, yet he was seeking a self-regulating machine, and he described it with admirable distinctness, and displayed it in drawings which "he who runs may read."

Lord Trayner: I don't know whether "he that runs may read," but I have looked at it a long time, and I cannot make much of it.

Mr. Jameson said the provisions showed two ways of winding, that of compound-winding with a thick and a thin wire; but they also showed to a great extent the proportion and sise of these wires which should be so wound. Brush had found that what he was really trying to get to was a machine which could adjust itself to varying modes of working, and could do so automatically. To do this it was necessary to have the mechanism of the magnet maintained at something like constant power, so that they might produce electricity sufficient to do their work. He might have thought more about currents than about potential, but be that as it may, his object certainly was to procure a machine which, as he said, would have the power constantly maintained.

Lord Trayner: Among these purposes was not the incandescent light.

Mr. Jameson proceeded to quote Mr. Brush's evidence, to show that his intention was to produce a machine to maintain a sufficiently constant potential for varying amounts of work. Mr. Jameson also pointed out that every one of the witnesses admitted that constant potential was not a thing that could be the subject of a patent. They could not patent the principle of constant potential, nor could they obtain a patent for a machine which in all circumstances would give constant potential, because constant potential depended upon the work to be done, the speed at which it went, the way it was done, and a number of things of that sort. Now, there could be no doubt that Brush's machine and this was particularly admitted by the pursuers' witnesses—did produce constant potential in certain cases.

Lord Trayner: There is no doubt Brush's machine is a very good one, and it has been very valuable, but the question is whether it was anticipated.

Mr. Jameson said his lordship had been invited to compare Varley's specification with Brush's as to disclosure as to what machine would be made upon the footing that neither of them knew, and that there was not in the specification set forth any object to be attained by a machine of this kind. Now that was not so. It was so with regard to Varley. Varley never made it one of his objects, and he did not claim it. Brush, on the other hand, set out with his object, not to obtain constant potential, but to patent something that would lead to it—some machine giving data of a certain kind. He explained that his object was to get a self-regulating machine, and he described how that was to be done, and set out in drawings how he wished to have it carried out. Therefore, in comparing one sentence of Brush's specification with one of Varley's they must keep in mind that Brush's specification was altogether occupied in describing a machine with magnets wound in this way for a particular object, while in Varley's specification there was no indication of what he was trying to get at, and there were lots of indications to a contrary effect. These indications were misleading, and would take a person away from the sense of the words of the specification assuming he was trying to describe compound-winding. It would not do to refer, for the purpose of comparison, to the specifications without showing that Varley's alleged anticipation of Brush referred to what Brush said in describing his machine. Brush had an object before him which he set forth, and which he proposed to accomplish in a well-defined way, aided by drawings which he set out. Coming to Varley's specification in 1876, he referred to the well-known lines on page 8 of the specification: "Part of the electricity developed by the machine is diverted to maintain the magnetism of the magnets, and the remaining portion is diverted to produce the electric light." The reference to the diversion of the magnetism must be to one of two things—either to the shunt or to separate excitation within the machine, such as they had in Wilde's machine and others. As Sir William Thomson had said in his evidence, the statement that the remaining portion was used to produce the electric light meant that it was used *only* to produce the electric light. That was a fair interpretation of the sentence in the specification as it stood.

Lord Trayner said the remaining portion might return for some purpose.

Mr. Jameson contended that there was no indication of that, and that an operative knowing nothing about the shunt, which was really unknown at this time, would naturally think only of what other methods were in vogue. Varley's statement that there were certain well-known modes of using the remaining portion of the electricity answered exactly to what was accomplished by Wilde and others, because in every one of these cases the electricity was developed in the machine. Part of it was also diverted and taken away to maintain the magnetism of the magnets, while the rest went to maintain the electric light. He, therefore, submitted that an ordinary intelligent electrical workman, at the date of Varley's patent, would be most likely to suppose from this part of the specification that the electricity would be developed by the machine, and not obtained by bifurcation in the way the shunt-series operation was. Alternatively, he submitted that taking this along with the rest of the specification there was really such a mass of incongruities that no workman would be led to wind a machine in this way or think of doing so. There was no well-known way of diverting the current by bifurcation. Shunt was not known in those days. No ordinary workman knew of it, and it was so little known that Hadden claimed shunt in his specification. The well known way of diverting the electricity referred to by Varley was not bifurcation at all, but by having a separate coil running upon the magnet brought from a separate part of the machine. It was simply a portion of the machine power cut off and sent straight to maintain the magnet, while the rest of the electricity went the other way. Of course there could be no anticipation of compound winding, even supposing there were two winds on the field magnet, for the one was series and the other was a winding led from a different part of the machine altogether. Mr. Jameson, in support of his contention, referred in detail to the evidence of Sir Wm. Thomson, whose verdict on Varley's specification, as a whole, was that it did not disclose a series-shunt machine as described by Hadden, and that any electrical workman of 1876 reading Varley's specification would have had disclosed to him a system of series shunt winding. That was the deliberate opinion of probably the greatest electrician of the day, who had followed all the changes and improvements in electricity. Looking at that specification, and putting himself in the position of a workman of 1876 with the knowledge of that time, that was Sir Wm. Thomson's deliberate opinion. This was of the very highest importance in this case, in which there was certainly a very heavy onus on the pursuer, for admittedly, until Crompton's case, there was no question of Brush having been the first person to disclose compound winding. Then Varley came forward with his specification, and said he disclosed this thing long ago.

Lord Trayner: There is always some point at which the question of an anticipation is brought forward.

Mr. Jameson: Yes; but it is generally an early point.

Lord Trayner: Not until it is somebody's interest to fight it, such as King, Brown & Co.

Mr. Jameson: But nobody ever heard of Varley's anticipation before Crompton's case. The extraordinary thing was that, moving in electrical circles, he never divulged or disclosed or claimed anything in connection with this compound-winding until this case of Crompton's arose, and then he had some negotiations, after the thing was done, with the Brush Electric Light Company. He (Mr. Jameson) did not lay much stress upon it, for no doubt Varley tried to make the best of his position. In his evidence Sir William Thomson went on to say that any ordinary workman would have been puzzled by Varley's specification, that he himself had been puzzled by some of the statements in it, and that the descriptions were such as to mislead the ordinary workmen. Some of the witnesses, again, said that the first two and a half lines of Varley's specification, if they described any portion of the shunt machine, described simple shunt, and nothing more.

Lord Trayner: If anybody goes that length he goes a good way, because, if these lines describe shunt, they undoubtedly describe a system of bifurcation. Yet, Mr. Silvanus Thompson says he cannot find any suggestion of bifurcation in these three lines at all.

Mr. Jameson said that was because the idea at that time was excluded, for there was no bifurcation known at that time in the electrical world. Of course taking off the current was quite well known in telegraphy. Then, another point, which Sir William Thomson made, and Dr. Silvanus Thompson and the other witnesses agreed with him, was that the idea of storing the magnetism was erroneous. They had good reason to believe from these things that Varley was not attempting to describe compound winding even had he at that time known of it. He was not attempting to describe it, and was not concerned to describe it clearly or minutely at all. If he had really believed that he had struck upon an important new invention which was important with regard to self-regulation, he should have seen that he secured the effect of it. It did not, however, matter a bit about this pet theory of Varley's, whether it was a compound machine or a shunt machine. It was not in the magnets he wanted higher magnetism, but in the bobbins. Now, there were a great number of other absurdities in this specification.

Lord Trayner: Is it material how many absurdities there are if you find shunt series described and disclosed. If you find series shunt disclosed, then these absurdities are of no moment.

Mr. Jameson: The series shunt as described here is a part of the machine and nothing more, and it would never occur to a workman who took this specification as a whole to fix upon this as describing a new mode of winding.

Lord Trayner: The workman in whose hands the specification was put in 1876 made a machine which was of compound winding.

Mr. Jameson: Yes, but under Varley's instructions.

Lord Trayner: No doubt, but that showed that Varley knew what he was doing.

Mr. Jameson said that if they were to believe that this machine was made expressly for this purpose, it was compound winding. But there was this observation to be made on that machine, that it was made as an experimental machine. It might be coupled up in many different ways, and had 10 terminals.

Lord Trayner: Although it had 10 terminals, it was compound winding all the same.

Mr. Jameson: It had double winding, but it was not series shunt.

Lord Trayner: In what other machine have you double winding wires of different resistance?

Mr. Jameson: I don't know of any.

Lord Trayner: You may have a machine with two coils of wire?

Mr. Jameson: You may have them quite well in the principle of different excitation.

Lord Trayner: Let me see in the evidence anything that indicates that in a machine which was series and had separate excitation within itself, that the coils of wire passing round the magnets were of different sizes.

Mr. Jameson: I don't think there is such a thing in the evidence. He contended that a workman reading Varley's specification might quite well think there were good reasons for having this wire for the excitation of the magnets of less resistance. It might maintain the electricity longer or detain the residual electricity longer, and it might have a more permanent effect with the currents passing it so many more times. Curiously enough, what Cromwell Varley foreshadowed was a coil of wire closed in itself all round the magnet to detain a certain amount of electricity or magnetism in the coils in which it was wound. That was a case of two coils of different resistance. There was such a hazy notion of the thing in Varley's mind that he was not likely to describe very clearly in the specification.

Lord Trayner: The question is, whether you have in this hazy expression a point which struck at series shunt by the use of two wires of separate resistance round some magnet, the principle of which was not known at the time, but is known now.

(*To be continued.*)

# PROCEEDINGS OF SOCIETIES.

## The Institution of Electrical Engineers.—May 23rd, 1889.

"On the Security against Disturbance of Ships' Compasses by Electric Lighting Appliances." By Sir William Thomson, D.C.L., F.R.S.S. (L. & E.), President.

The danger to be avoided is sufficiently explained in the following short statement by Mr. William Bottomley, which appeared in the *Nautical Magazine* for December, 1885:—

"The following example of a case which might occur in any large ship, will show the amount of error which may be produced on the compass" [by the electric lighting apparatus] "unless precautions are taken to guard against it.

"Suppose a main lead from the engine room to the fore part of the ship, to light up 100 lamps, is brought along the centre of the ship. It may be at a distance of 10 metres, or 33 feet, from the standard compass, and will run almost underneath it. If we suppose that each lamp takes one ampère of current there will be a current of 100 ampères altogether in this lead. Now, the effect" [of an infinitely long straight current] "on the compass" [above it] "at a distance, $D$, in centimetres is given by the formula

$$F = \frac{2 \times \frac{1}{10} C}{H D}$$

where $C$ is the current in ampères, and $H$ is the horizontal magnetic force. In this case we have $C = 100$ ampères and $D = 1{,}000$ centimetres. Therefore

$$F = \frac{20}{1{,}000\ H} = \frac{0{\cdot}02}{H}.$$

At Glasgow the horizontal force may be taken as 0·15 in C.G.S. units, therefore the effect on the compass will be $\frac{{\cdot}02}{{\cdot}15} = \frac{1}{7{\cdot}5}$. This will be expressed in degrees by multiplying by 57·3, the number of degrees in the radian, or angle subtended at the centre of a circle by an arc equal in length to the radius. Therefore, the amount of error produced by such a current on the compass will be $\frac{57{\cdot}3}{7{\cdot}5} = 7{\cdot}6$ degrees.

"The foregoing refers to a single wire and a continuous current machine, but if an alternate current machine is employed no effect will be produced on the compass even when the ship's side is used for the return. When a continuous current machine is used, the danger of producing an error on the compass can be avoided by using two wires close to one another, but these wires should be well insulated from the ship's side. If in any way" [two points of] "one of the wires is brought in contact with the iron of the ship there may be no change observable in the lighting, but the current may produce as much error on the compass as it would if there was only a single wire.

"The following points should therefore be attended to in all cases of lighting ships by electricity:—

"First.—With continuous current machines two wires, well insulated, should always be employed.

"Second.—The insulation of the wires should be tested periodically; if any connection with the iron of the ship is found, the fault should at once be made right.

"Third.—When an alternate current machine is used, a single wire may be employed and the iron of the ship used to complete the current without producing any effect on the compass.

"What makes this question of the greatest importance is that the error may be produced without ever being detected by the officers of the ship. On board ship the errors of the compass are usually determined during the day, in the morning and afternoon, but the electric light is only used at night. The captain may therefore carefully determine his errors every day, and set his course quite correctly; but at night, when the electric light is turned on, the ship may be going several degrees off her proper course, although she is being correctly steered by the compass.

"In connection with the lighting of ships with electricity, there is another point which should also be attended to—that is, the position of the dynamo. If it is placed near an iron bulkhead, the upper end of which is near the compass, the bulkhead may become magnetised by induction so powerfully that it will produce a considerable error on the compass.

The subject was also referred to in Mr. Bottomley's paper on "The Magnetism of Ships and the Mariner's Compass," read before the Society of Arts, January 28th, 1886, and published in the Journal of the Society for February 5th, 1886. In the discussion which followed, and in which Captain Creak, of the Admiralty Compass Department, Mr. Alexander Siemens, and Dr. Hopkinson took part, it appeared that in three ships, lighted on the single-wire system with direct currents, small but not unimportant errors in the compass, due to the lighting currents, had been actually observed. Since that time several cases have been reported to me of large passenger ships, lighted with direct currents on the one-wire system, in which as much as 4° or 5° of error on the compass has been produced by the electric lighting. In the latest of these cases, a few weeks ago, an error of 4° on the North course was found when the light was put on. The light was put on and off several times with the ship's head north, and every time the same error was produced.

The precautions for security which I have to suggest are:—

1. The use of the two-wire method exclusively (unless, which is now rarely the case, alternate currents are used).

2. A differential galvanometer on the two mains for the lighting current to show approximate enough equality of the out-going and in-coming current. A rough and cheap instrument (on the old telegraph "detector" plan) would, I believe, suffice: and would be valuable for the electric lighting system (independently of the compass question) to give timely warning of any faults or accidental contacts or failures of insulation sufficient to cause any considerable difference in the strength of the currents carried by the two mains.

3. Care that there is not magnetic "leakage" from the dynamo (as practical men, guided by Faraday's ideas, theory, and language, have now taught the scientific world to call it) enough to produce any compass-disturbance of practical moment. Capt. Creak, speaking at the end of 1885, in the Society of Arts discussion previously referred to, said that in one ship the direct compass-disturbance produced by the generating machine was "felt through a distance of 55 feet," and across iron bulkheads, and that it was perceptible also in other ships of the Royal Navy electrically lighted on the two-wire system.

My impression is that the improved dynamos now made have much less of magnetic leakage than those made prior to 1886, but we still want information as to their disturbing magnetic effect at such distances as have to be considered in connection with the compass question.

4. To ascertain that there is no perceptible compass-disturbance, or if there is any to test its amount, the compass should be observed while the current through the dynamo is started, and stopped, either by starting and stopping the dynamo itself, or by making and breaking the circuit of the field magnets. This should always be done before the electric light installation is taken over from the contractors. It is best and most easily done when the ship is in dock, or lying steadily at anchor. On no account ought it to be delayed, in a new ship, till she goes out for compass adjustment. A determination of the amounts of the disturbance, if any, for all courses of the ship can be made by aid of my deflector without moving the ship. But a sufficient practical test may be made by first observing the effect of starting and stopping the current, on the compass as it stands; then adjusting a small magnet placed on, or supported a little above, the glass of the bowl, to deflect the compass about 45° first on one side and then on the other side of its undisturbed position, and in each case observing the effect of starting and stopping the electric current. This effect ought not to be as much as 2° in any of the three cases.

5. A small electric lamp may safely (and with very great advantage in most cases of electrically lighted ships*) be used to light the compass. The effect, if any perceptible, of its current on the compass ought to be tested in the manner described in No. 4.

## MAY 23RD, 1889.

Discussion on Sir W. Thomson's note "On the Security against Disturbance of Ships' Compasses by Electric Lighting Apparatus." (*Authorised Abstract.*)

In opening the discussion, Captain CREAK said he was glad Sir William recommended the two-wire system, for that in itself was a great safeguard against disturbance. So far as his own experience goes, most trouble arises from magnetic leakage due to the employment of machines having considerable external field, and placing them in positions with respect to the iron of the ship that such field was directed towards the compass. In one case (H.M.S. *Northampton*), where three such machines were used, an error of 11° was produced when all the machines were running, and three correction tables were necessary.

Mr. ALEX. SIEMENS, as an advocate of the single-wire system, thought it quite unnecessary to use two wires, for in all his experience, extending over many ships fitted on the single-wire system, only one instance had occurred in which complaint was made, and in this case the wiring was done before the position of the compass had been decided upon, the spot eventually chosen being in close proximity to the leads. As a proof that the single-wire system could be made satisfactory, he mentioned that his firm made enquiries on all vessels fitted by them every time they come into port, in order to ascertain whether any inconvenience arises from the electric lighting apparatus, but with the exception above quoted no complaint has been made. Referring to Mr. Bottomley's letter mentioned in the paper, Mr. Siemens said the screening effect of the decks had been entirely neglected in the calculations there given. A second case of disturbance had come under his notice by his being asked to inspect a ship fitted by another firm, and the maximum deflections produced were ½° and 1½° on the standard and steering compasses respectively. As regards the position of dynamos, he had found no appreciable effect at distances greater than 50 feet.

Prof. G. FORBES, speaking of H.M.S. *Northampton*, said that the dynamos referred to by Captain Creak were placed in an iron room, and still the disturbance produced was very serious. From an examination of the machines of the type there employed h found that the leakage mainly comes from the parts of the yokes near their junction with the cores, but he had reason to believe that in the more modern machines the leakage has been considerably reduced.

Prof. JAMIESON mentioned the case of ss. *Bombay*, in which the steering compass was disturbed 9°; the fault was traced to a wire about 4 feet from the compass, and remedied by running a return wire-

Mr. RAWORTH, in corroborating Mr. Siemens with regard to the great convenience of the single wire system, gave additional details respecting the second case mentioned by Mr. Siemens. The compass was influenced by either of two converging wires running along lower passages, according as the needle was parallel to one or to the other. On examining the decks the iron was found cut away between the wires and the needle, and the defect was remedied by enclosing the former in 3 inch iron pipes.

Major CARDEW described his experience in lighting binnacles electrically, as suggested by Sir W. Thomson in his note, and although he carefully twisted the leading wires together, the filament seriously affected the compass reading.

Sir W. THOMSON, in reply, said that caution was necessary in arranging lamps for lighting compasses, and in answer to Prof. Forbes expressed an opinion that alternate currents if used in such lamps would not demagnetise the needles. Referring to the screening effect of decks, he pointed out that Captain Creak's observations proved them to be of little use in neutralising the external field of dynamos, and to be efficient the iron required to be very thick. The decks may, however, considerable reduce the action of currents on the compasses, especially where the circuits are completed between two decks, but when the wires pass from one deck to another, the screening effect is much reduced. Although the conductors in the single wire system may be placed so as not to affect either one of the two compasses generally used, yet it is very difficult to arrange that neither are disturbed; and as any disagreement between the two (especially as the difference may vary with the portion of the ship being lighted) further complicates the navigation, Sir William felt sure it would be far the best plan to adopt the two wire system in all cases.

The discussion on Mr. Mordey's paper on "Alternate Current Working" was deferred till the next meeting on May 30th.

## "Alternate Current Working," by W. M. MORDEY.

(*Continued from page 640.*)

### *Secondary E.M.F. of Transformers.*

THE best potential difference to be used on transformer circuits has been a good deal discussed, especially with reference to the voltage of lamps. It is very desirable to arrive at some conclusions on this matter, not only as to glow lamps, but as to the general question.

The balance of opinion—which is, however, not very decisive—appears to be in favour of using 50-volt rather than 100-volt lamps, so far as durability of the lamp is concerned. The stout low-tension filament should last longer than the finer one for high tension, because disintegration does not so soon reduce the cross section to the breaking point. It is, however, not a question only of life, as the disintegration of the thick filament causes blackening of the globe; and if it can be shown that this blackening, and the consequent lowering of the effective light, is more serious than in 100-volt lamps, then the advantage of slightly longer life will not of itself be sufficient to recommend 50-volt lamps in preference to others of higher voltage.

Of course, the most serious objection to lowering the voltage is the increased cost of the secondary conductors. This is not important in small and very compact installations such as can be so readily supplied by transformers—for instance, in small shops and ordinary houses, where a separate transformer may be placed within a few yards of the lamps, and where the fall of potential is negligible: but for larger work it is advisable to keep the potential difference high, as with direct currents, and for the additional reason that the use of very large alternate currents, with correspondingly large conductors, is accompanied by the inconveniences arising from the high virtual resistance already alluded to.

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* Those who know the trouble of keeping the best of ordinary compass lamps alight, for the steering compass on the bridge of some of our cross-Channel steamers in a winter's gale, will appreciate this advantage.

It is impossible, however, to choose an E.M.F. that will meet all requirements. For instance, high candle-power lamps are coming largely into use, and as this practice extends, higher E.M.F. will be demanded in order to keep down the diameter of the "stick."

But, on the other hand, lamps of small candle-power can be more easily made for low than for high voltage; and as there is a growing tendency to use small candle-power lamps which in many situations give all the light that is required, this point should be kept in mind, especially as it is very probable that before long a demand will spring up for lamps of three or four candles. I know it will be said that it is easy to reduce the candle-power of ordinary lamps by inserting an impedance coil in the circuit. This is one of the many conveniences of transformer working, but it should not be resorted to for permanent purposes, as, however little power such a coil may absorb, lamps reduced in that way, being worked at less than their normal candle-power, are very inefficient.

Then there is another reason for sometimes preferring 50 volts to 100 volts, that I should like to mention, and that is that alternate current arc lamps do not require more than 50 volts terminal pressure. It may be expected that many such lamps will be used on transformers—for instance, at small business places, where perhaps the bulk of the lighting will be internal and by incandescence lamps, but where it will be convenient to have one or two arcs outside. We know that when arcs are used in parallel with incandescence lamps on direct current circuits, it is necessary, in order to get the best results, to have 12 to 15 volts drop of pressure in a fixed resistance in series with each arc. Thus has arisen the custom of using 65 volts for mixed arc and glow lamp circuits, where the potential difference at the arc lamp terminals is reduced to about 50 volts by the insertion of such a resistance, the incandescence lamps, however, being made to work at 65 volts.

This is a very wasteful arrangement, but, apart from its wastefulness, 65 volts is a very inconvenient pressure, both from the manufacturer's and the consumer's point of view. It does not lend itself to combination as does a pressure of 50 volts dynamos, lamps, or transformers, for 65 volts cannot be used in pairs on 100-volt circuits as can such apparatus for 50 volts. It is an irregular and inconvenient pressure that is demanded by the necessities of direct currents, but that, I am glad to be able to say, need not be imported into alternate current work.

This very serious loss can be almost entirely avoided with alternate current arcs, as the necessary steadying effect is readily obtained by the use of an impedance coil, absorbing much less power than does a resistance; and as such arcs require only 35 to 40 volts between the carbons, instead of 45 to 50 with direct currents, it is sufficient to provide 50 volts potential difference between the secondary conductors.

But it may be said that, as impedance coils absorb little power, the arc lamps may be put on 100-volt circuits in parallel. This may be done without much objection so far as the lamp and impedance coil are concerned, but there is the drawback that the "plant efficiency" of the transformer will then be low.

The output of a transformer is limited partly by the size of the conductor. The actual output of a 100-volt transformer supplying arcs through impedance coils will not be much more than the product of the current × 50 volts, while for the same output in watts on glow lamps it would only have to yield about half the current. Therefore we see that, although not inefficient, the maximum allowable output of a 100-volt transformer on parallel arc lamps is only about one half of its ordinary maximum output.

It will be said that two arcs may be run in series on the 100-volt secondary. This is true, but two arcs are not always wanted; and, further, the working of two arcs (which must for this purpose be shunt or differential instead of simply series wound) in series on a constant potential difference is the least satisfactory way of arranging arcs, whether for direct or alternate current, as in this way they affect one another the most; having neither the margin of controlling power, by current, which is provided in the parallel constant potential difference arrangement; nor by E.M.F., as in the series constant current arrangement. Then, again, lamps so connected must be extinguished together, as no cut out or switch can be used unless it is made to insert a resistance or impedance to take the place of the extinguished lamp.

On the whole, therefore, it is preferable to have 50-volt secondaries where arcs are to be used, or to adopt the intermediate plan of connecting the middle of the 100-volt secondary to a third terminal, using a third wire for any arcs or 50-volt lamps that may be required. It may be worth while to point out that the use of a third wire on transformer circuits may lead to difficulty if not carefully considered. With a single transformer it is as easy to use three or any other number of terminals for the lamps as it is to do so on a set of accumulators, and to get any corresponding potential difference. The various sections of the secondary may be unequally loaded by this arrangement, but the primary responds as a whole to the demand made upon it. If, however, instead of a single transformer, two transformers are used, with their primaries and secondaries respectively in series, then the use of the three-wire principle is only possible when it is applied to both the primary and secondary circuits, unless the load on each of the two secondaries is always to be alike and the same, in which case, as scarcely need be said, there is no particular advantage in using three wires. If the loads are not equal on the two, then the primary of the least loaded transformer acts as an impedance coil to the other primary, and all power of self-regulation is lost. One remedy for this is to apply the three-wire principle to the primary as well as to the secondary; but this is a serious matter, and one that could only be undertaken where the whole service demanded it. Another plan is to have two mains for the primary and three for the secondary, and to join the primaries parallel, the secondaries being in series with the third wire at the middle terminal.

In cases where arcs have not to be used, and in the absence of any very strong evidence of any difference of life in favour of 50-volt lamps, I think it is best to use 50 volts for small separate installations, and 100 volts for larger ones; but it is evident from what has been said that there are so many points to consider that it is quite impossible to give any definite negative or affirmative reply to the question, "What is the best secondary E.M.F. to use?" Each case, or at least each class of cases, must be settled on its merits. If for general convenience any particular pressure is selected, it is obvious that it will have about equally strong arguments for and against it.

### *Alternate Current Arcs.*

Reverting to this subject, it is to be regretted that very little appears to be commonly known about A.C. arcs. I trust that in the discussion of this paper some information may be furnished with regard to them.

As to the regulating mechanism of lamps, although some difficulties were encountered in modifying the Brush arc lamp for this work, the result has been perfectly satisfactory; the feeding range is very small—quite as small as with direct currents, and with no greater loss of power in the lamp-box. Some trouble was experienced in getting rid of noise and vibration in the coils and mechanism, but this has been completely overcome, the lamp itself being quite silent. This is readily proved by connecting the carbon-holders by a flexible wire and adjusting the current to the normal value, when it is found that there is no noise. An A.C. arc is not silent, as is well known, a distinct hum being set up, by which it is quite possible to ascertain the periodicity.

This humming noise, which can scarcely be expected to be overcome, renders A.C. arcs unsuited for general use indoors; but for outside illumination, and for such places as railway stations, they will certainly find a very extensive application.

I venture to think that the opinion so often expressed, that A.C. arcs give much less light than those supplied with direct current, is founded on a misunderstanding of the proper conditions. It is quite true that if two arcs are compared, supplied with the same amount of current, the direct-current lamp will prove the better one. This, I think, is because the basis of comparison is not right. In many cases the A.C. arcs are more efficient. They should be judged by the energy, and not only by the current. I have mentioned that an A.C. arc requires only 35 to 40 volts potential difference between the carbons, while a direct-current arc requires 45 to 50 volts. The mean may be taken at 37·5 volts and 47·5 volts respectively, and to expend the same energy in the two cases the current should therefore be in the inverse ratio of these values. Thus an A.C. arc, to give the same light and to absorb the same power as a 10-ampère direct-current arc, should be made for 12·6 ampères.

In one respect A.C. arcs are inferior, and that is in their power of directing the light downwards. They have no "crater," and therefore do not send the light down as do direct-current arcs. On this account it is advisable to use reflectors above them, unless they are suspended below and near a good reflecting ceiling or roof.

But even this drawback is counteracted in parallel work by their greater efficiency. On a 65-volt circuit with direct currents, as I mention elsewhere, there is a waste of 100 to 150 watts with a 10-ampère arc, and in the same proportion with other currents. This is a very serious proportion of the whole power, and it is only allowable to waste it because, as a light-producer, the arc is so much more efficient than the incandescence lamp. Nevertheless, any means of avoiding the loss is to be welcomed, and with A.C. arcs it may be greatly reduced by the use of impedance coils, which, if properly designed, waste very little power, and have all the steadying effect of resistances.

### *Safety and Safeguards.*

I take this opportunity of bringing up this question, not because I have anything new to say with regard to it, but in order, if possible, to bring it a little nearer to a rational settlement.

It will be acknowledged that the first duty of an "undertaker" using high tension is to provide for the complete and absolute safety of the consumers. If there are no means of doing this, then the system is fundamentally bad, and must sooner or later be abandoned.

There are several ways of protecting the house mains more or less completely. I only need allude to three typical plans, all of which have already been discussed before this Institution.

One is the plan introduced by Mr. Kent, of entirely separating the primary and secondary conductors in a transformer by a sheet or division of earth-connected metal. This is open to adverse criticism on some points, but on the whole it is an effective plan.

Another arrangement is the ingenious one of Captain Cardew, consisting of a sort of static mouse trap, which immediately goes off when an unauthorised P.D. enters it.

The third plan is that of earthing the secondary, and it would be very instructive if those who so strongly oppose this plan would state just one real objection to it. It is a perfectly sure method, and costs nothing.

It renders it absolutely impossible for the consumer to get a dangerous shock under any possible combination of circumstances whatever.

The faults that may occur are :—

(*a*) Contact between primary main or mains and earth.

(*b*) Contact between primary and secondary in a transformer.

(*c*) Contact between a person and a portion of the secondary conductor.

(*d*) Contact between that person and earth.

Now if all these contacts occur at the same time, the "person" will get a shock.

But if the secondary is earthed, no shock can be obtained, except, perhaps, a slight one due to the secondary P.D.

This simple plan has been approved by almost everybody, but it is received with opposition on the part of some of the fire insurance offices and others.

It is difficult to ascertain where the supposed danger is. If the secondary is earthed, the effect of a contact between primary and secondary, when the former is accidentally leaky, is at once to blow out the primary safety fuse of the transformer, and so cut out the offending house. This is the simplest and the best course to take, and prevents the continuance on the circuit of transformers that contain faults.

The Brush Corporation has adopted this plan with perfect success on a large installation abroad, and intends adhering to it where local circumstances permit.

It is to be remarked that it is not open to the objection that has been stated against earthing of one of the primary conductors, viz., that the telephones may be affected, for it is not permanent. The moment a contact occurs that could lead to a disturbance of the telephones, the fuse prevents that disturbance being continued.

While effectually removing life risks, this precaution does not increase fire risks; in fact, it tends to greater safety, as it is some sort of check on the character of the house wiring work, and so reduces chances of faults such as short circuiting of the secondary.

The rupture of a primary safety fuse is not a serious matter, and in any case it is only what takes place under ordinary circumstances when any fault occurs that results in an excess of current.

As to static effects, I think it will be found that there will always be enough general leakage to prevent such effects being a cause of difficulty, even if the secondary circuits are not earthed.

### *Hysteresis and Eddy Currents.*

Some explanation is necessary by way of preface to this section of the paper. The experiments described were made with a direct current dynamo, and on that account they only touch the fringe of this division of the subject. As I had no suitable alternator, I was unable to pursue the question as far as I wished to do, but I hope I need make no apology for bringing forward such results as I have been able to arrive at.

As far as I am aware, no simple or practical method is known by which the power absorbed in eddy currents can be determined and separated from that due to hysteresis in the armatures of dynamos. This is a point of some importance both as regards alternators and direct current machines, for many reasons; one of the principal being that in the absence of extra knowledge on these matters it is difficult or impossible to determine to what extent the lamination of the iron cores should be carried. There are wide differences in the practice of the various designers and makers of dynamos in the thickness of the iron used.

Lamination may be carried to such a degree of fineness for the purpose of reducing eddy-currents as to add very materially to the cost of production, the iron increasing rapidly in price as the thickness is reduced; and it may be that the point is sometimes passed beyond which no gain in efficiency is obtained. This is a question we wish to be enabled to settle.

Until Professor Ewing[*] and Dr. J. Hopkinson[†] read their Royal Society papers on the subject, very little was known of the heating effect of changes of magnetism. Professor Ewing opens the part of his paper dealing with this matter in the following terms (p. 552, *Phil. Trans.*) :—

"The energy expended in a cyclic process of magnetisation can take no other form than that of heat diffused throughout the substance of the metal. Experiments have been made by Joule and others to determine by direct observation the heating effect of magnetisation in iron.[‡]

"In most direct measurements of this quantity no distinction is made between the heating effect due to the induction of electric currents and that due to changes of magnetisation *per se*; and so excellent an authority as Professor Rowland, writing in 1881, has expressed himself as doubtful whether changes of magnetisation, considered apart from the currents they induce, give rise to any development of heat at all."

Further on, Professor Ewing, referring to the dissipation of energy by hysteresis, which he had determined by laboratory experiments, says (*Phil. Trans.*, pp. 553, 554) :—

"These developments of heat are so small as to make it apparent that the very considerable thermal effects which reversals of magnetism cause in the revolving cores of some dynamo-electric machines must be due almost wholly to the internal induction of currents, so far as they are not due directly to the current circulating in the coils of the armature.

"The experiments have a practical value in showing that cores which are so thoroughly laminated as to render the induction of currents within them unimportant, do not involve any serious loss of energy; and that the efficiency of a machine with a soft iron core or cores whose magnetism is periodically reversed need not, on that account, be materially less than that of a machine which has no such cores. The absence of iron from the armature has been claimed, on the score of efficiency, as an important advantage possessed by some types of machine, but unless the claim has some other basis it appears to me to be illusory. Magnetic reversal does involve some loss of energy, but if the cores are properly laminated it is so small as to be practically insignificant."

I quote these passages as showing the position of the question; Professor Ewing and Dr. Hopkinson give laboratory determinations of the magnetic loss in iron with various inductions, and under various conditions. It is, however, left somewhat in doubt as to whether the loss in dynamo armatures will be the same as in the laboratory experiments, the conditions being very different in the two cases.

On this point Professor Ewing shows that hysteresis is much less when the iron is in a state of mechanical vibration than when it is in a state of rest, and states that in a dynamo the loss will be less than the experiments on still metal might lead us to expect.

Another way in whch the dynamo conditions may cause some difference is the possible variations of the magnetic density that may exist in the core. Such variation may be considerable in armatures of large size.

Dr. Hopkinson (*Phil. Trans.*, p. 467) takes the magnetic loss in armatures as being the same as in the small pieces of iron tested by his method, and gives an example calculated for an armature "finely divided, to avoid local electric currents."

It is to be noted, then, that both these authorities regarded eddy currents as unimportant in laminated armatures; but in the later paper on "Dynamo-electric Machinery"[*] Drs. J. and E. Hopkinson published their famous investigation into the efficiency of dynamos, and gave very full particulars, from a study of which it is possible to ascertain the loss in eddies, on the assumption that the method of calculating the magnetic loss is correct when applied to armatures—a point which Dr. Hopkinson was not able to decide positively; but by assuming that it is applicable, then, by subtracting the calculated hysteresis loss from the ascertained total power unaccounted for, the eddy current loss is obtained; and as this process gives the hysteresis as accounting for only about 40 per cent. of the total loss in the armature core, it shows that the eddies could not by any means be considered unimportant, although the lamination was carried out to the extent of making the iron about 0·02 inch thick.

(*To be continued.*)

## CORRESPONDENCE.

### Sparking through Insulation.

In your issue of May 3rd you quote from a circular of mine as follows :—"It takes over 100 times the electromotive force to spark through or disrupt the same thickness of insulation when iron pipe is used instead of lead. We should be glad to have details of the experiment by which Mr. Brooks arrived at this marvellous conclusion."[†]

You shall now have the details. When lead pipe is drawn over a cable it has been practically impossible to prevent bubbles of air getting into the insulation.

When the lead-encased cable is coiled and uncoiled, the space occupied by these bubbles becomes enlarged, and converted into a partial vacuum. A vacuum of this kind is much more easily disrupted than the air itself. This can be demonstrated by an arrangement like that shown by Mr. Acheson, and figured in Mr. Verity's paper, page 361 of the *Electrical Engineer*, May 3rd. This consists principally of two adjustable screws, one connected to the lead pipe and the other to the conductor. If we adjust those screws so close that they will barely admit a sheet of letter paper between the points, and apply the sparks of a Holtz machine to take its choice between a vacuum $\frac{1}{32}$nd of an inch existing between the conductor and the lead encasing, the spark takes the choice of the vacuum. The distance between the two points, compared to the length of the vacuum, is somewhere near 1 to 50? This is one of the principal causes of disruption in lead-encased cables. Again, if we take the same conductor and same thickness of insulation, and draw it into an iron pipe, and fill it with my liquid, you can spark four inches through the air before you can disrupt the insulation.

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[*] Professor Ewing, "Experimental Researches in Magnetism," *Phil. Trans.*, January, 1885.

[†] Dr. J. Hopkinson, "Magnetisation of Iron," *Phil. Trans.*, April, 1885.

[‡] Joule, *Phil. Mag.*, vol. xxiii., 1843; Grove, *Phil. Mag.*, vol. xxxv., 1849; Villari, *Nuevo Cimento*, 1870; Cazin, *Ann. de Chem. et de Phys.*, 1875; Trowbridge, *Proc. Amer. Acad. of Arts and Science*, 1879.

[*] *Phil. Trans.*, part 1, 1886, p. 331.

[†] This should be understood in connection with what was before stated: a lead pipe with a solid insulation, and an iron pipe with a liquid insulation.

We put to you the question: How much greater electromotive force will be required in the latter case over the former to spark through the insulation?

I stated before it required 100 times more electromotive force; I think I can safely state now that it will require a thousand times more electromotive force.

In any insulation that is of a solid nature (I say solid in the sense that it differs from a liquid) any imperfection or leak in this solid insulation is developed into a perfect earth by heavy currents.

On the contrary, with a liquid the case is entirely different. All insulating liquids contract and expand by changes of temperature, and it is as difficult to establish and develop a leak or fault in them as it is a leak or fault through the air.

For further details, see my article in New York *Electrical World*, February 16th, 1889.

Now for a little history. In 1882 I learned that the Pennsylvania Railroad were about to put underground wires between their station in Broad Street, Philadelphia, and their station at Thirty-Second and Market Streets, a distance of about one mile and one-third. I made an offer to lay the conductors, and if they did not work satisfactorily they need not pay for them. They replied that was fair and generous; but they did not wish to try any experiments and be left without service. They intended to use kerite, and said they knew it was expensive, but it would work, as it had been used across the Delaware river, a distance of one mile, for nearly 10 years.

The kerite cost over $100 per mile per conductor, not counting the conduit and the expense of laying.

In less than two years these conductors began to give out, and were replaced by another set of a different manufacture, of which rubber is the basis of the insulation; but in about the same length of time these also began to fail.

I then made another application and told the general superintendent that I would lay a cable at cost, and reserve payment until the end of two years, and then I would forfeit payment if there were any signs of deterioration. At the expiration of two years I got my money.

These conductors have been connected to overhead wires running to New York, Pittsburg, and Washington. They have been subject to atmospheric electricity, and we get up that article here in first-class style and quantity. Not one of the conductors has been interrupted for a moment.

Thunderbolts are generally regarded as having some electromotive force as well as light and noise, but the insulation of none of the conductors has ever been disrupted. The insulation now is higher than at the start, the last test was for the poorest, 8,258 megs. per mile, and the highest 19,512 megs. per mile, and these measurements were made by an electrician of the Pennsylvania Railroad Company.

Many patents have been taken out to prevent disruption in cables. I have had a hand in the business, and my patents are now in the custody of Messrs. Johnson and Phillips, London, to whom I refer my English friends for further particulars.

**David Brooks.**

Philadelphia, Pa., *May 16th*, 1889.

[The terms of Mr. Brooks's circular certainly did not make plain what he now explains in his foot note.—EDS. ELEC. REV.]

### On Lightning.

Five years ago you were good enough to reprint in your excellent journal my paper from the *Philosophical Magazine*, "On a Property of the Magneto-Electric Current to control and render Synchronous the Rotations of the Armatures of a number of Electro-Magnetic Induction Machines."

The importance which is now attached to this paper by electrical engineers, together with the prominence given to the subject of it in the current number of the REVIEW, induces me, in the interests of electrical science, to ask you to kindly reprint another forgotten paper of mine, "On the Influence of Gas and Water Pipes in determining the direction of a Discharge of Lightning." This paper I think of equal importance to the former reprint, and may be of much use to electricians at the present time.

**Henry Wilde.**

*June 3rd*, 1889.

[The paper to Mr. Wilde refers will be reprinted in our next issue.—EDS. ELEC. REV.]

### Safety and Safeguards.

Now that the greater portion of London has been given up to the alternating current system of supply, the question of protecting the consumer from the dangers of high tension becomes of more importance than ever. I fear, however, little will be done in this direction unless it be made compulsory, and enforced by some such authority as the Board of Trade.

Next arises the question as to what is the simplest and best method of affording the needed protection. Mr. Mordey, in his recent paper read before the Institution of Electrical Engineers, advocated putting the secondary direct to earth, and challenged objection. Prof. Ayrton, I believe, has also recommended this simple device as affording every protection. No doubt, from an electrical point of view, it is all right, but there are nevertheless at least two objections to putting any portion of the system direct to earth which may fairly be raised. In the first place it would throw a permanent and severe strain upon the wiring and fittings generally of an installation, and thereby shorten its life. Weak places would rapidly develop and lead to mischief, so that those who have to make good the damage might reasonably object. Secondly, there is the unfortunate consumer to be considered. Now I hold that any additional strain thrown upon the wiring of a house simply means additional expense in meeting that strain, and I utterly fail to see why the consumer should be burdened with additional expense (already sufficiently great) consequent upon the "undertaker" having selected a system of supply which entails some risk to the consumer. For these reasons alone, therefore, it seems to me Mr. Mordey's scheme is objectionable, and looking at the question from the other side, I should prefer some such device as that recommended by Mr. Arthur Wright, viz., putting the secondary to earth *through* a very high resistance inductionless coil, which would cause a tumbler to fall and short circuit the secondary terminals whenever the P.D. exceeded a safe limit, thus blowing out the primary fuse, and cutting out the transformer from the circuit. Surely this would afford sufficient protection, without throwing a severe strain upon the insulation.

The importance of some such protection cannot be gainsaid. The loss of a single life in handling an electric light fitting would, perhaps, be fatal to the high tension system in this country, and Mr. Mordey has done well in again raising the question, which I trust will yet receive that attention it deserves in certain high quarters.

**H. Human.**

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